

Faculty of Medicine and Health Sciences

Effectiveness of Acceptance and Commitment Therapy and Structured Exercise Program on Defense Mechanism and Eating Behavior in Relation to Body Mass Index among University Students

Patricia Pawa Pitil

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Effectiveness of Acceptance and Commitment Therapy and Structured Exercise Program on Defense Mechanism and Eating Behavior in Relation to Body Mass Index among University Students

Patricia Pawa Pitil

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DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgements have been made, the work is that of the author alone. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.



……

Signature

Name: Patricia Pawa Pitil

Matric No.: 18010081

Faculty of Medicine and Health Sciences

Universiti Malaysia Sarawak

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ABSTRACT

Obesity is a significant public health issue among Malaysians and is rising among university students. Following the COVID-19 pandemic and the restrictions imposed by the government through the Movement Control Order (MCO), the prevalence rate of being overweight or obese has been increasing. The lack of physical activity and unhealthy eating behaviors have influenced the body weight of university students. Individuals who are obese may experience weight-related psychological defense mechanisms, be at risk of having poor eating behaviors, and have a display of immature or neurotic defense styles. However, there is limited research that studied the effect of behavioral treatment combined with a structured exercise program, in addressing the issues with neurotic defense styles. The Acceptance and Commitment Therapy (ACT) has shown to be effective in managing body weight issues; however, the effect of including a structured exercise program is not known. This study consists of two phases. Phase one explored the prevalence of being overweight and obese among students from two public universities in Sarawak. Phase two investigated and compared the changes in the Acceptance and Action Questionnaire for Weight (AAQW) score (weight-related psychological flexibility (WRF)), Body Mass Index (BMI), and eating behaviors in overweight and obese university students with immature or neurotic defense styles. The participants were assigned to receive either Acceptance and Commitment Therapy (ACT), Acceptance and Commitment Therapy with structured exercise (ACT-EX), or be placed in a control condition for a six-week, three-arm randomized controlled trial (RCT). The prevalence of being overweight or obese was high. Four out of ten university students were either overweight or obese. The older age group (> 25 years old) and male students were significantly more overweight and obese. The Asian cut-off point for the BMI category was used as a reference. The results from the RCT showed that the ACT-EX was significantly more effective in reducing the AAQW score (improved WRF),

BMI, and eating behaviors than the ACT alone. A more mature defense style was displayed among the participants who received the ACT rather than the ACT-EX. Overall, this study adds further support to the effectiveness of ACT interventions in weight management, WRF, and eating behaviors. Individuals who are overweight or obese (OW/OB) tend to employ less adaptive defense styles; however, this can be altered with the ACT intervention. Furthermore, the integration of exercise in ACT-EX makes it more prominent for weight loss and improving WRF and eating behaviors among OW/OB university students. With the evidence from this study, it is worthwhile to recommend psychologists, health professionals, and fitness trainers integrate ACT with structured exercise to achieve the goal of a weight management program that would likely sustain psychological flexibility in terms of weight, eating behaviors, and defense styles.

Keywords: Acceptance and commitment therapy, BMI, defense style, eating behavior, exercise, weight-related psychological flexibility

Kesan Terapi Reda dan Komitmen (ACT) dan Program Senaman Berstruktur terhadap Mekanisme Pertahanan dan Tingkah Laku Makan dalam Hubungannya dengan Indeks Jisim Badan di Kalangan Pelajar Universiti

ABSTRAK

Obesiti merupakan isu kesihatan awam yang signifikan di kalangan rakyat Malaysia dan semakin meningkat di kalangan pelajar universiti. Selepas pandemik COVID-19 dan sekatan yang dikenakan oleh kerajaan melalui Perintah Kawalan Pergerakan (PKP), kadar prevalen menjadi gemuk atau obes telah meningkat. Kekurangan aktiviti fizikal dan tabiat makan yang tidak sihat telah mempengaruhi berat badan pelajar universiti. Individu yang mengalami obesiti mungkin mengalami mekanisme pertahanan psikologi yang berkaitan dengan berat badan, berisiko mengalami tingkah laku makan yang buruk, dan menunjukkan gaya pertahanan yang tidak matang atau neurotik. Walau bagaimanapun, kajian yang terhad mengenai kesan rawatan tingkah laku yang digabungkan dengan program senaman yang terstruktur dalam menangani masalah dengan gaya pertahanan neurotik. Terapi Reda dan Komitmen (ACT) telah terbukti berkesan dalam menguruskan isu berat badan; namun, kesan menyertakan program senaman yang berstruktur masih tidak diketahui. Kajian ini merangkumi dua fasa. Fasa satu mengkaji prevalens berat badan berlebihan dan obes di kalangan pelajar daripada dua universiti awam di Sarawak. Manakala, Fasa dua mengkaji dan membandingkan perubahan dalam skor Acceptance and Action Questionnaire for Weight-Related (AAQW) iaitu fleksibiliti pesikologi berkatan berat badan (WRF), Indeks Jisim Badan (BMI), dan tingkah laku makan di kalangan pelajar universiti yang berlebihan berat badan dan obes dengan gaya pertahanan tidak matang atau neurotik. Peserta menerima ACT, Terapi Reda dan Komitmen dengan senaman berstruktur (ACT-EX) atau dalam keadaan terkawal untuk percubaan terkawal secara rawak (RCT) selama enam minggu. Kadar prevalen menjadi gemuk atau obes adalah tinggi. Empat daripada sepuluh pelajar universiti adalah gemuk atau obes. . Mereka

lebih lazim dalam kalangan kumpulan umur yang lebih tua (> 25 tahun) dan pelajar lelaki. Menggunakan ukuran Asia untuk kategori BMI adalah sangat digalakkan. Hasil kajian daripada RCT ini menunjukkan bahawa ACT-EX berkesan dalam mengurangkan skor AAQW, BMI dan meningkatkan tingkah laku makan berbanding ACT. Gaya pertahanan yang lebih matang dipaparkan di kalangan peserta yang menerima ACT berbanding dengan ACT-EX. Secara keseluruhan, kajian ini menambah sokongan terhadap keberkesanan intervensi ACT dalam pengurusan berat badan, WRF, dan tingkah laku makan. Individu yang mempunyai berat badan berlebihan atau obes (OW/OB) cenderung menggunakan gaya pertahanan yang maladaptif; bagaimanapun, ini boleh diubah dengan campur tangan ACT. Tambahan pula, integrasi senaman dalam ACT-EX menjadikannya lebih ketara untuk penurunan berat badan dan peningkatan WRF dan tingkah laku makan di kalangan pelajar universiti yang OW/OB. Dengan bukti daripada kajian ini, adalah berfaedah untuk mengesyorkan ahli psikologi, profesional kesihatan, dan jurulatih kecergasan mengintegrasikan ACT dengan senaman berstruktur untuk mencapai matlamat program pengurusan berat badan yang berkemungkinan dapat mengekalkan fleksibiliti psikologi dari segi berat badan, tingkah laku makan, dan gaya pertahanan.

Kata kunci: *Terapi reda dan komitmen bmi, gaya pertahanan, tingkah laku pemakanan,senaman, fleksibiliti psikologi berkaitan berat badan*

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LIST OF ABBREVIATIONS

CGS	Center for Graduate Studies
UNIMAS	Universiti Malaysia Sarawak
ACT	Acceptance and Commitment Therapy
ACT-EX	Acceptance and Commitment Therapy + Structured Exercise Program
AAQW	Acceptance and Action Questionnaire for Weight
BMI	Body Mass Index
CG	Control Group
CR	Cognitive Restraint
UE	Uncontrolled Eating
EE	Emotional Eating
OW/OB	Overweight or Obese
WRF	Weight-Related Psychological Flexibility

CHAPTER 1

INTRODUCTION

This chapter presents the study's background, problem statement, objectives, significance, scope, and expected outcomes.

1.1 Study Background

Obesity is characterized by having an excessive amount of body fat. The World Health Organization (WHO) reports that the prevalence of obesity increases each year. Furthermore, it is the tenth most common health problem in the world (WHO, 2017). The categorization of body weight is technically done via body mass index (BMI). The weight of a person in kilograms is divided by the square of his or her height in meters (kg/m^2). For the Asian population, overweight refers to a BMI between 23.0kg/m^2 and 27.4kg/m^2 whereas the BMI cut-off point for obesity is from 27.5kg/m^2 to 34.9kg/m^2 (Zainudin et al., 2011). Instead of the conventional BMI cut-off point that was tailored for the Western population, this set of cut-off points should be used to measure the BMI of the Asian population to avoid overestimating or underestimating the prevalence of overweight and obesity in the Asian population.

Despite various intervention programs that target diet modification and physical activity, the prevalence of obesity continues to rise in many countries. Obesity can predispose to various morbidities, such as cardiovascular diseases, metabolic diseases, and orthopaedic injuries (Kyrou et al., 2018; Powell-Wiley et al., 2021). Obese individuals are also predisposed to psychological risks (Sarwer & Polonsky, 2016). To date, physical conditions associated with individuals with excess body weight have been widely established. In contrast, the psychological risks are still not well established.

The second National Health and Morbidity Survey (NHMS) reported that 20.7% of adults were overweight and 5.8% were obese (Ismail et al., 2002). By NHMS 2015, these figures had risen to 30% and 17.7%, respectively (IPH, 2015). The most recent NHMS report from 2019 indicated further increases, with 30.4% of adults being overweight and 19.7% obese (IPH, 2020). This trend shows that nearly half of the adult population in Malaysia is either overweight or obese. The NHMS 2023 survey revealed a combined percentage of 54.4% for overweight and obese adults (IPH, 2024), indicating that this condition needs urgent intervention. University students are also part of this concerning category, underscoring the necessity for targeted health measures among young adults.

Most of the youth population consists of college or university students between the ages of 18 and mid-twenties. They experienced substantial changes during the transition from high school students to college attendees. They are expected to exert more self-control, independent thinking, and self-directed learning (Stok et al., 2018). In addition, they also undergo the early adulthood phase, during which they experience the need for peer acceptance and the tendency to conform to societal and environmental norms. These young adults experienced various struggles in their lives. It is crucial for them to combat the multiple stressors that they face in a positive manner. One of the stressors is the body weight issue. The primary cause of overweight and obesity is an energy imbalance that develops over time. This imbalance occurs when a person consumes more calories than they burn off. The modern environment fosters a tendency toward the development of obesity, i.e. combination of a sedentary lifestyle, physical inactivity, and cheap, high-calorie foods (Chan et al., 2017). University students are not spared the same exposure as they commonly consume unhealthy food, either due to financial constraints or easy access to these kinds of foods (Mansor et al., 2016). Many university students struggle to maintain a healthy body weight at the crossroads of early adulthood. It is reported that 38.5%

of university students in Malaysia are overweight or obese (Wan Mohamed Radzi et al., 2019). Another recent study reported the obesity prevalence among them as 22.2% and 16.9% respectively (Pitil & Ghazali, 2022). In other words, this highlights a worrying trend, as at least four out of 10 university students are overweight or obese.

Defense mechanisms are psychological constructs used by individuals to keep them functioning well psychologically in their daily lives (Freud, 1966). It is an unconscious effort adopted by individuals to overcome excessive anxiety (Waqas et al., 2015). As lifestyle changes can be massive during university years, students often deal with academic demands, financial concerns, social support, and dietary needs, which can cause tremendous psychological distress (Arias-de la Torre et al., 2019; Knapstad et al., 2021). Therefore, some defense styles are applied to manage these experiences, one of them being body weight issues. Psychological defense mechanisms in relation to concerns about body weight plays an important role in the health-related behaviors of university students (Baceviciene et al., 2020). The increasing prevalence of OW/OB among university students can negatively impact their body image. Body image issues and eating disorders are major health concerns that can emerge at an early age before persisting into adulthood (Neumark-Sztainer et al., 2018). Even if some individuals are likely to be underweight or have normal weight, they might still perceive themselves as having an undesirable body weight and size due to an immature defense mechanism.

The denial of a specific situation, for instance, denying oneself as being normal weight and continuing to work hard to reduce or gain weight, is an example of an immature defense style. There are three types of psychological defense mechanisms, ranging from the least adaptive to the most adaptive, i.e. immature, neurotic, and mature defenses. A mature defense style is associated with better self-awareness and consciousness of reality. In contrast, immature

and neurotic styles are more likely to be maladaptive. The immature defensive category is the most commonly applied. It encompasses all defenses in the aspects of action, self-denial, and image distortion. In contrast, the neurotic defense style is the middle range of adaptiveness, and it includes all defenses belonging to the neurotic and obsessional defense levels. The denial of a specific situation, for instance, denying oneself as being normal weight and continuing to work hard to reduce or gain weight, is an example of an immature defense style.

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In contrast, the neurotic defense style is the middle range of adaptiveness, and it includes all defenses belonging to the neurotic and obsessional defense levels (Vaillant, 1971b). Increased body weight is related to the least adaptive defense style (Mazurkiewicz et al., 2021). Denial is an immature defense mechanism. It is an act of refusing to accept the unwanted internal experience, thus also known as experiential avoidance (Cramer, 2015). Defensive avoidance is common in individuals with high BMI because they refuse to accept the reality of being overweight to avoid anxiety (Täuber et al., 2020). The denial of acting on the current

situation of being overweight or obese warrants a behavioral intervention that can exert a more lasting effect among the overweight or obese population. Understanding how defense mechanisms manifest in relation to body weight issues among this demographic is crucial for effective intervention strategies. Thus, it is worthwhile to be examined in this study.

Eating behavior is one of the most important elements in managing body weight. The Three-Factor Eating Questionnaire (TFEQ) (de Lauzon-Gullian et al., 2004) is one of the instruments used to examine eating behaviors associated with the development of obesity. There are three categories of eating behaviors: uncontrolled eating (UE), cognitive restraint (CR), and emotional eating (EE). UE is the urge to overindulge as a result of a lack of control over food and a sense of hunger. As a result, UE can lead to excess calorie intake and subsequent weight gain in an individual. Next, CR eating behavior represents the urge to limit food intake. Those who are obese often apply CR as a strategy to regulate diet intake as compared to normal-weight individuals (Megalakaki et al., 2013). In comparison, EE is characterized as the tendency to eat in response to unpleasant feelings or negative emotions such as stress (de Lauzon et al., 2004). The more frequently they experience negative emotions, the more frequently they would use food to ease their emotion, thus leading to imbalanced energy. Therefore, the ability to identify and regulate emotions is necessary to reduce these eating behaviors in the management of body weight issues among obese adults (Kim et al., 2021).

Moreover, psychological flexibility is critical in the weight loss program. In terms of weight-related matters, it is often referred to as weight-related psychological inflexibility or difficulties. Experiential avoidance is one of the characteristics of psychological inflexibility. It is the unwillingness to stay in touch with uncomfortable feelings about weight and eating, like a craving for food or feeling tired, and the unsuccessful attempts to avoid, control, or change

these feelings (Lillis et al., 2009). To help overweight and obese individuals develop a healthier and more acknowledged relationship with their eating behavior, body weight, and weight-related psychological inflexibility, it is essential to target psychological processes that are associated with weight gain. A lower level of psychological flexibility is related to poorer psychological wellbeing among obese adults (Guerrini Usubini et al., 2021). Therefore, it is insufficient to focus solely on weight loss to promote the health and wellbeing of overweight and obese individuals.

Most of the research on psychological flexibility has focused on Acceptance and Commitment Therapy (ACT), an empirically based therapy founded by Steven Hayes, a cognitive-behavioral approach aimed at addressing individuals who engage in avoidance when experiencing difficult thoughts and feelings (Hayes et al., 1999). It is a third-generation cognitive-behavioral approach that uses acceptance and mindfulness, commitment, and behavioral change processes to produce psychological flexibility by defusing difficult thoughts and accepting difficult feelings while persisting in value-based action (Hayes et al., 2006). This therapy includes six psychological processes, namely acceptance, defusion, self-as-context contact with the present moment, values, and committed action (Hayes et al., 1999). Rather than attempting to control inner events, the ACT promotes acceptance of unpleasant experiences. The avoidance of dealing with negative situations has been associated with negative outcomes. Thus, with experiential avoidance or denial, weight problems among individuals who struggle with bodyweight issues may continue to be unresolved. ACT is effective in reducing weight-related self-stigma, improving health-related behaviors (Levin et al., 2018; Palmeira et al., 2018; Petersen et al., 2021), and increasing physical activity in overweight and obese individuals (Palmeira et al., 2017; Tapper et al., 2009). However, limited research has explored the effectiveness of ACT in promoting psychological flexibility and

addressing obesity among university students. Consequently, ACT appears to be a promising acceptance-based intervention for managing overweight or obesity among this population.

Lastly, the impact of exercise on weight loss is well studied. To achieve weight loss, exercise is recommended as an integral part of the weight loss program (Weiss et al., 2017). Physical activity and exercise are commonly used synonymously. Physical activity can be defined as any bodily movement that creates energy expenditure, while exercise refers to planned and structured physical activity (Caspersen et al., 1985). Achieving the recommended level of physical activity may help produce weight loss (Colbery et al., 2010) as a result of higher energy expenditure over energy intake. On the other hand, overweight or obesity occurs when energy intake exceeds energy expenditure (Hafekost et al., 2013; Hill et al., 2012). As a result, strategies to combat obesity should focus on strategies to increase physical activity and modifications of eating behaviors.

Despite the claims of most exercise professionals that a combination of exercises such as intense training and group exercise and healthy eating can reduce obesity, the trend keeps rising yearly. Therefore, it is time to shift the focus to the psychological aspect by evaluating the behavior of the affected population in relation to body weight issues. It is well-established that the key to losing weight hinges on the combination of good nutrition, physical activity, and behavior modification. Literature has documented the efficacy of ACT in weight management and weight loss; however, the integration of structured exercise with ACT is not discussed in the literature. Furthermore, there are very few studies on the outcome measures of the three components of weight loss, namely eating behavior, weight-related psychological flexibility (WRF), and defense mechanism changes.

1.2 Problem Statement

The outbreak of COVID-19 has caused considerable disruptions to daily schedules, heightened stress levels, and emotional strain, potentially resulting in alterations to dietary patterns and levels of physical activity. Previous studies have indicated that individuals with higher BMI are more prone to gaining weight during periods of disruption to their usual routines, such as holidays (Diaz et al., 2017). Of particular concern is the heightened vulnerability of overweight or obese individuals to complications associated with COVID-19 (Poppin et al., 2020). Furthermore, the pandemic has had a profound impact on mental well-being, with the burdensome psychological effects potentially contributing to emotional eating, reduced physical activity, and exacerbation of weight gain (Di Renzo et al., 2020; Ammar et al., 2020).

The prevalence of obesity among university students in Malaysia is a growing concern. Data from 2011 revealed that more than 33.6% of university students were overweight or obese, with the highest prevalence observed among females and younger students (less than 30 years old) (Mohamud et al., 2011). By 2019, this figure had risen to 38.9% (Wan Mohamed Radzi et al., 2019), indicating a concerning upward trend. A recent study reported even higher rates, obtained during the earlier phase of the RMCO, with overweight and obesity combined reaching 40.1% (Pitil & Ghazali, 2022). These alarming statistics underscore the urgent need to address this issue effectively.

During university years, students are prone to unhealthy eating and the consumption of high-calorie food that can lead to excess body weight. Furthermore, in the phase of early adulthood, appearance and social acceptance are significant for them (Sevindi, 2020). Poor eating behavior can be counterproductive in this manner. Although many obesity-related studies have been conducted in Malaysia (Chan et al., 2017; Mohamad Nor et al., 2018; Mohd-

Sidik et al., 2021), most of them were epidemiological analyses. Consequently, there is a gap in the research on effective anti-obesity interventions, especially with regard to psychological-based interventions. Such intervention is widely accepted and practiced in many other countries. However, its application in weight management remains scarce in Malaysia (Force, 2018; Jin, 2018). In addition, a high level of physical activity can lead to weight loss (Johnson et al., 2021). However, the effectiveness of a combination of physical activity and behavioral treatment is yet to be explored.

University students undergo many changes drastically in many aspects of their lives during the transition from high school to the university environment. They also start living independently away from home and their parents. As a result, many adaptations are required in their daily lives. As described in the classic work of Sigmund Freud in 1874, defense mechanisms refer to strategies used by individuals to protect themselves from suffering (Waqas et al., 2015). In all its vast complexity, the human mind applies defense mechanisms in the face of problems or setbacks in society and life in general.

Avoidance and psychological defense mechanisms are two interconnected concepts commonly utilized by individuals to manage stress and anxiety (Vaillant, 2011). Defense mechanisms refer to unconscious techniques people employ to shield themselves from uncomfortable feelings or circumstances. Conversely, avoidance refers to the conscious or unconscious attempt to steer away from situations that induce distress (Hayes et al., 2004). The relationship between avoidance and psychological defense mechanisms is complex. While avoidance can be considered a type of defense mechanism, individuals may employ avoidance to shield themselves from distressing events and memories. However, Hayes et al. (2004) view avoidance as a maladaptive behavior that impedes an individual's ability to navigate daily life effectively.

To enhance weight management outcomes, tailored interventions targeting defense mechanisms are crucial. Mazurkiewicz et al. (2021) found a correlation between higher body weight and the least adaptive defense style, whereas Alipour et al. (2016) and Arafa et al. (2014) have associated psychological factors such as stress and negative emotions with weight gain. According to Täuber et al. (2020), individuals with high BMIs commonly engage in defensive avoidance, refusing to acknowledge their overweight status to alleviate discomfort. Baceviciene et al. (2020) have demonstrated that psychological defense mechanisms significantly influence how student populations manage health-related concerns about body weight. However, as the majority of available literature focuses on the benefits of exercise, few studies have examined changes in defensive style and weight loss.

Previous research has established that overweight and obese individuals often display maladaptive eating behavior compared to the normal-weight population (Brytek-Matera et al., 2018). Emotional eating, uncontrolled eating, and restrictive eating are some of the problematic eating behaviors (Wnuk & Du, 2017). With increasing evidence linking problematic eating behavior and obesity worldwide, eating behavior should be incorporated into the behavioral modifications to promote weight loss. Nevertheless, the evidence surrounding behavioral modifications among those in denial of their body weight issue using structured exercise programmes remains inconclusive. Furthermore, while exercise is recognized as a key component of weight loss programs, there is a lack of research on the integration of structured exercise with psychological interventions like ACT. This gap in knowledge underscores the need for comprehensive approaches that address both the physical and psychological aspects of obesity.

In light of these gaps in the literature, this study aims to investigate the effectiveness of ACT and a structured exercise program in addressing defense mechanisms, eating behaviors,

and weight-related psychological flexibility among university students. By filling these knowledge gaps, this research seeks to contribute to the development of more holistic and effective interventions for combating obesity among university students in Malaysia and beyond.

1.3 Research Objectives

i. To explore the prevalence of OW/OB among university students during COVID-19 pandemic.

ii. To examine the effectiveness of ACT on weight-related psychological flexibility (WRF), BMI, eating behavior (CR, UE and EE) and defense styles (mature, immature and neurotic) of the university students.

iii. To examine the effectiveness of ACT and structured exercise program (ACT-EX) on WRF, BMI, eating behavior (CR, UE and EE) and defense styles (mature, immature and neurotic) of the university students.

iv. To compare the effectiveness of ACT and ACT-EX on WRF, BMI, eating behavior (CR, UE and EE) and defense styles (mature, immature and neurotic) of the university students.

1.4 Research Hypotheses

i. Hypothesis 1: There is a significant difference in WRF between ACT, ACT-EX and CG (control group) across the three time points (baseline, post-intervention and follow-up)

ii. Hypothesis 2: There is a significant difference in BMI between ACT, ACT-EX, and CG across the three time points (baseline, post-intervention and follow-up)

iii. Hypothesis 3: There is a significant difference in the mean score of eating behavior (CR, UE, and EE) between ACT, ACT-EX, and CG across the three time points (baseline, post-intervention and follow-up)

iv. Hypothesis 4: There is a significant difference in the mean score of defense styles (mature, immature and neurotic defense style) between ACT, ACT-EX, and CG across the three time points (baseline, post-intervention and follow-up)

1.5 Significance of the Study

The findings from this study will be able to highlight the impact of acceptance-based therapy on an individual's body weight and eating behavior. The effects of the defense style were examined by comparing the two types of interventions, i.e., ACT alone or a combination of ACT and structured exercise program. With the increasing prevalence of overweight or obesity, many studies have been conducted to examine the effectiveness of obesity interventions. This study aims to evaluate the effects of the psychological approach on unhealthy behaviors related to body weight control among university students.

Based on the study outcomes, an intervention program could be proposed to the relevant stakeholders in the universities, ministries, and non-government organisations in order to combat the major public health issue of overweight and obesity. Furthermore, the research findings provide a comprehensive understanding of the psychological mechanisms of obesity to the public, health practitioners, exercise trainers, and researchers. With increased awareness and understanding of these issues, psychological interventions can be designed in a more meaningful mechanism to improve the health outcomes of overweight or obese individuals.

Lastly, the study findings can be used to promote the importance of healthy lifestyle awareness in promoting mental and physical wellbeing. Future researchers can refer to our study results to expand the scope of future studies.

1.6 Scope of the study

The primary aim of this study is to examine the efficacy of an ACT-based intervention (Hayes et al., 2006; Hayes et al., 1999) in improving the psychological aspect of weight loss and eating behavior, specifically among university students who are struggling with overweight and obesity. Participants with high scores in immature and neurotic defense styles were recruited if they are found to be in the overweight or obese category. They went through interventions in the form of structured physical exercise of moderate intensity (65-85% of maximum heart rate or a Borg scale of 11-13) with three sessions of 24-hour recovery between sessions for six weeks. In addition, the ACT was conducted at the rate of one session per week for six weeks, which covers the six core aspects of the therapy: being present, values, commitment, self-as-context, defusion, and acceptance. Following that, individual and group change trajectories were analyzed based on WRF, BMI, and eating behaviors.

1.7 Expected Outcomes

The findings of this study provide critical information to psychologists, mental health professionals, and sport psychologists who manage clients with body weight issues as well as fitness trainers who are helping overweight or obese clients to improve their lives. As the psychological approach to managing body weight issues among Malaysians is still in its infancy, this study highlights the potential of using ACT to improve the physical and psychological wellbeing of individuals with long-term body weight issues. More specifically, the study results benefit in improving the quality of life of university students with body weight and eating behavior issues.

1.8 Conceptual and Operational Definitions

1.8.1 Obesity

Conceptually, the Asian cut-off point for obesity is defined as having a BMI of 27.5kg/m^2 to 34.9kg/m^2, while the BMI of overweight ranges between 23.0kg/m^2 and 27.4kg/m^2 (Zainudin et al., 2011). Operationally, the terms overweight and obesity are used interchangeably in this study. Therefore, it is measured by dividing body weight in kilograms by height in meters squared (kg/m^2).

1.8.2 Acceptance Commitment Therapy (ACT)

Conceptually, ACT is the treatment for experiential avoidance disorder. Experiential avoidance disorder is defined as the intentional efforts of individuals to evade or avoid triggers in the form of intrapersonal events such as feelings, thoughts, memories, and physically nagging feelings (Hayes et al., 1996a)

Operationally, ACT is measured as an outcome of a highly structured and organized therapy (Hayes et al., 2006). It aims to increase psychological flexibility, i.e. WRF in this study, through six psychological processes of change, namely: acceptance, defusion, being present, self-as-context, values, and behavioral commitments.

1.8.3 Defense Mechanism

Conceptually, a defense mechanism is defined as the individual's reaction to emotional conflicts and external stressors (APA, 2013).

Operationally, the defense mechanism in this study is measured with the defense Style Questionnaire-40 (Andrews et al., 1993). This inventory measures the three types of defense styles, including mature, immature, and neurotic. This study includes participants with immature and neurotic defense styles.

1.8.4 Psychological flexibility

Conceptually, psychological flexibility implies the ability to be in touch with the present moment and how an individual is completely aware of emotions, sensations, and thoughts, and

welcomes them, even the unwanted ones. It also refers to how an individual behaves in the pursuit of chosen values (Hayes et al., 2011).

Operationally, this study examines the WRF, which is the main focus of the ACT intervention among the overweight and obese population.

1.8.5 Eating Behavior

Eating behavior is a broad term that encompasses food choices and motives, feeding practices, dieting, and eating-related problems such as obesity, eating disorders, and feeding disorders (LaCaille, 2013).

Operationally, this study examines the three types of eating behaviors by using TFEQ-18, namely cognitive restraint (CR), uncontrolled eating (UE), and emotional eating (EE).

1.9 Chapter Summary

The first chapter described with a brief background of the topic and a description of the problem and knowledge gap. This was followed by the research objectives, research hypotheses, and significance of the study. The scope of the study and the expected outcomes are explained before moving on to the conceptual and operational definitions.

1.10 Theoretical Framework

This study focuses on OW/OB university students and their maladaptive defense styles. It explores the effects of two interventions, Acceptance and Commitment Therapy (ACT) and ACT combined with exercise (ACT-EX), compared to a control group. The study assesses key dependent variables: BMI, Weight-related Functioning (WRF), defense styles, and eating behavior. This theoretical framework aims to understand how these interventions impact these variables among OW/OB university students (Figure 1.1).

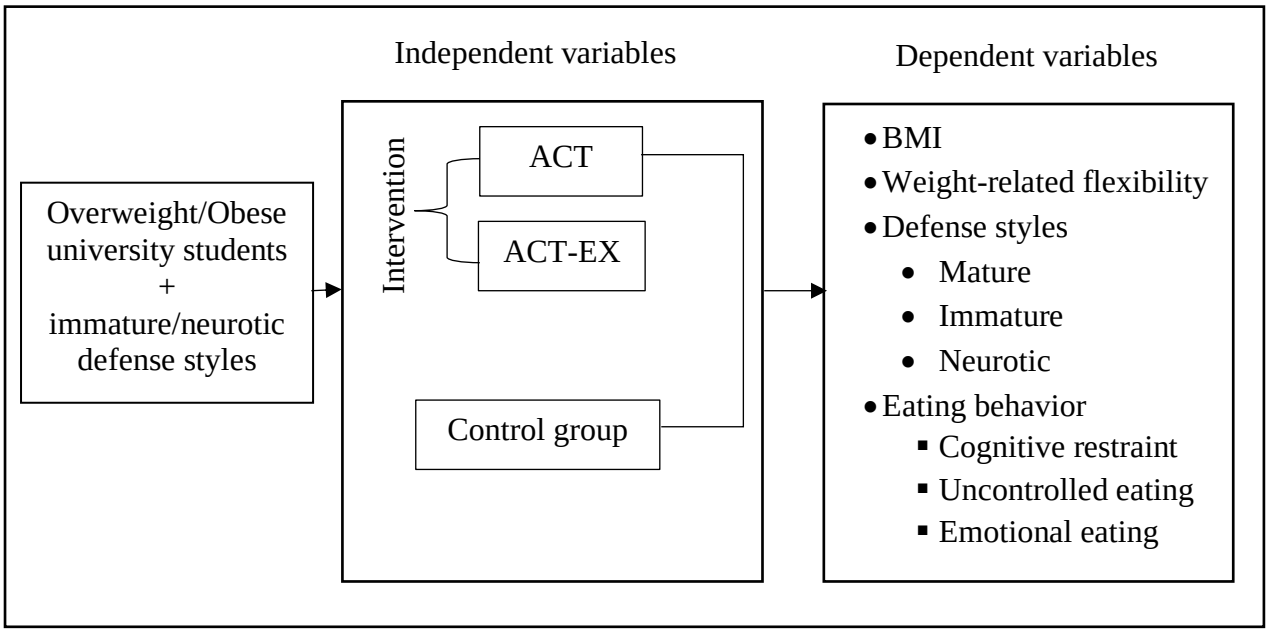


Figure 1.1: The theoretical framework examines OW/OB university students with maladaptive defense styles, using the interventions of ACT and ACT-EX, compared to a control group, to examine the dependent variables: BMI, WRF, defense styles, and eating behavior.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

This chapter provides an overview of the previous research on overweight and obesity phenomena, psychological defense mechanism, eating behavior, and ACT and behavioral treatments as they relate to the current study. Several previous research gaps will be discussed and highlighted. Included is a review of studies evaluating the effectiveness of various interventions on weight-related and psychological outcomes associated with weight management. The wide range of data that could be included in this literature review is crucial given the nature of the subject. Along with the research framework that underlies this study, this chapter also introduces some theories related to it.

2.2 Overweight and obesity epidemic

In both emerging and developed nations, the prevalence of OW/OB among adults is increasing, making obesity one of the top causes of death globally (Cencin et al., 2019). As a result, there are increased health concerns and issues related to body weight. The worldwide prevalence of obesity nearly tripled between 1975 and 2016. Obesity affects 650 million people aged 18 and above worldwide. This represents approximately 13% of the world's adult population. Evidently, females are more obese than males (15% vs. 10%) (WHO, 2017).

The National Health and Morbidity Survey (NHMS) conducted in Malaysia has documented a troubling increase in the prevalence of overweight and obesity (OW/OB) among adults over recent years. In the NHMS 2011, the prevalence of overweight and obesity among Malaysian adults was recorded at 29.4% and 15.1% respectively (IPH, 2011). This trend continued to worsen by the NHMS 2015, which reported an increase to 30.0% for overweight

and 17.7% for obesity (IPH, 2015). Alarmingly, the 2019 NHMS indicated a further rise in these figures, with 30.4% of adults being overweight and 19.7% classified as obese (IPH, 2020). This means that one in two Malaysian adults is either overweight or obese. The most recent NHMS 2023 survey has reported an even more significant increase, with the combined percentage of overweight and obese adults reaching a staggering 54.4% (IPH, 2024). Consequently, Malaysia has been ranked as having the highest obesity rates among Asian countries for several years, showing no signs of decline.

Body Mass Index (BMI) excess is strongly associated with an elevated risk of numerous health problems. These include hypertension, diabetes, heart attacks, and other chronic diseases that significantly impair quality of life (IPH, 2020). Over the past two decades, Malaysia has undergone rapid modernization, which has brought substantial changes to the lifestyle of its citizens. These changes encompass both physical activity levels and dietary patterns. As the country modernizes, a decline in physical activity has been observed, particularly as individuals age. This decline is compounded by the shift towards a more sedentary lifestyle, influenced by urbanization and technological advancements that reduce the necessity for manual labor and physical exertion in daily life.

Furthermore, the dietary patterns of Malaysians have evolved, with a notable increase in the consumption of high-calorie, high-fat foods (Goh et al., 2020). Traditional diets, which were once rich in vegetables, fruits, and lean proteins, are being increasingly replaced by Westernized diets characterized by fast food, sugary beverages, and processed snacks. These dietary changes contribute significantly to the caloric surplus that fuels the obesity epidemic. The combination of reduced physical activity and unhealthy eating habits creates a perfect storm for weight gain and associated health issues. Studies, such as those by Romieu et al. (2017), have highlighted that the obesity epidemic is exacerbated by this dual impact. As

Malaysians adopt more sedentary lifestyles and consume more energy-dense foods, the risk of developing obesity and its related health complications increases.

Overweight and obesity have also been associated with psychological well-being (Sarwer & Polonsky, 2016). Individuals who are overweight or obese may experience difficulties with their mood, self-esteem, quality of life, and body image. Optimistically, weight loss is often linked with gains in psychosocial status and functioning (Carraça et al., 2018). This will be discussed further in this review, especially on the psychological aspects of overweight or obese individuals.

Students in higher education are typically individuals who have just entered the adult phase of their lives. It is the stage in life when people make the shift from being dependent on their parents to becoming fully independent. As a result of the increased level of personal responsibility that comes with being a university student, students learn how to make decisions during their time there. At this stage, most of the activities in the daily routine are created by eating habits and physical activities. Most of the university students have been reported to have poor nutrition as a result of this transition (Cheikh Ismail et al., 2022; Gan et al., 2011) as a consequence of a very stressful academic and time management. Their level of physical activity has also changed, which would affect their energy balance as well. University students in Malaysia have reported an increase in sedentary behavior and weight gain during the COVID-19 confinement (Tan et al., 2021). This present study was conducted during the COVID-19 pandemic, from March 2020 onwards. With two years of little physical activity, it could make this population more likely to become OW/OB.

2.2.1 Prevalence of physical activity, sedentary behavior and OW/OB among the university students

Five universities participated in a cross-sectional study to examine the prevalence of OW/OB among Malaysian university students (Alanzi et al., 2019). Thirty-eight percent were overweight (21.7%) and obese (16.8%) from the total of 1778 participants. This prevalence was higher as compared with other countries at the time of the study (Peltzer et al., 2014). A new framework for addressing obesity was unveiled; it was developed based on the lifestyle of university students. Six latent variables—funding source, demographics, mental health, lifestyle, healthy dietary intake, unhealthy food intake, and BMI—as well as one observable variable make up the research model. The most important independent variables are the source of financial and demographic data, and the significant predictor variable is BMI. Lifestyle (social media use, study time, sleep hours, physical activity, working, smoking habit), a healthy diet (e.g., vegetables, fruits, and whole grains), mental health (e.g., stress, happiness), and an unhealthy diet (e.g., fast food, soft drinks, and chips) are the mediators. Following the findings, stress, social media use, and eating unhealthy foods (such as fast food and soft drinks) have the greatest influence on Malaysian university students' problems with OW/OB.

Overweight and obesity were studied for their association factors, involving university students from 22 countries (Peltzer et al., 2014). Dietary behavior and physical activity revealed the most associated OW/OB among the university students besides socio-demographics, social factors, and mental health. These universities were from low- and middle-income countries. Only Laos, Philippines, Singapore and Thailand were the countries representing the Southeast Asia. Even though the study recruited a university from each country, a similar pattern of dietary behavior and physical activity caused the overweight and obesity among the students. Consequently, university students have the same habits in many countries. This convinces the

need to examine the eating behavior of the university students and the relationship with body weight.

A study examined two countries, Malaysia and Indonesia, on the physical activity, sedentary behavior, and weight status of the university students during the COVID-19 lockdown (Tan et al., 2021), reporting notable yet interesting findings. During the lockdown, several restrictions were made to curb the spread of the coronavirus. Therefore, the Government of Malaysia closed all learning institutions and exercise facilities to maintain social distancing. In response to the country's uncontrolled outbreak, Indonesia followed suit. The convenience sampling and snowball sampling techniques were used to collect the data in December 2020. This cross-sectional study included two sets of participants: 107 Indonesian undergraduate students and 147 Malaysian undergraduate students from private universities in Central Java and Selangor, respectively. The potential participants were made available through a web-based, self-administrated survey that was placed on Google Forms. The participants self-reported their gender, age, body height (cm), pre-COVID-19 pandemic weight (kg), and post-COVID-19 pandemic weight (kg). The participants recalled their body weight prior to the COVID-19 pandemic. In this investigation, the BMI before and during the COVID-19 pandemic was also recorded. The BMI was then classified into four categories based on the Asian-Pacific cut-off points (underweight, normal, overweight, and obese) (Lim et al., 2017). Using the self-reported International Physical Activity Questionnaire-Short Form (IPAQ-SF), sedentary behavior and physical activity were assessed.

The results revealed that a high percentage of the students were physically active during the confinement: Malaysians, 79.6% and Indonesians, 77.6%. On the other hand, a sedentary behavior of greater than eight hours per day was higher among Malaysians (53.1%), as

compared to Indonesians (36.4%). Parallel to this, there was no significant difference between the BMIs of Indonesian students (22.01 ± 3.76 kg/m^2) and Malaysian students (22.83 ± 4.93 kg/m^2) during confinement (t = 1.507, p = 0.133). Nevertheless, notwithstanding these results, there was an increase in the BMI of Malaysian and Indonesian students throughout the pandemic (up 2.24 % and 1.57%, respectively). With a median weight gain of 2 kg, 57.8% of the 147 Malaysian students who responded to the survey gained weight during the COVID-19 pandemic. Indonesian students likewise showed a similar pattern, with nearly half of respondents (47.7%) reporting weight gain. This study supports the phenomena of weight gain during the confinement among university students.

There was a study that examined the factors associated with BMI among 311 university students at one public university in Malaysia (Mokhatri et al., 2015). The body weight categorization followed the WHO guideline, whereby 25.1% were overweight and 3.9% were obese (overall, 29.1%). Males had a higher OW/OB rate than females, while married students exhibited higher BMI than single students. The impact of marriage on eating habits could contribute to the higher BMI among married students. Age was also associated with the BMI of these students. Those who were older had a higher BMI. The level of income was assessed, revealing that those who had a lower level of income had a higher BMI. The BMI of smokers was higher than that of non-smokers. The carbohydrate intake and physical activity had significant relationships with BMI. Interestingly, the psychological factor, which was anxiety, was associated with the BMI of the students. Those with a high BMI had a lower anxiety. This finding revealed a link between body weight categories and psychological status. This was also found in another study (Tantawy et al., 2020). The reason behind this finding could be that, particularly among men, people with lower body weights seem to have a poorer perception of their bodies than those with higher body weights. This observation may be partially explained

by the fact that some men view a smaller body as undesirable; this viewpoint may be supported by societal norms.

This study, however, recruited Iranian graduate students as respondents, thus the findings could not be generalized to university students in Malaysia. The BMI cut-off point used could underestimate the prevalence of overweight and obese students. Therefore, this emphasizes the relevance of the BMI cut-off point, which was the objective of this present study.

2.3 Eating behavior among Malaysian young adults/university students

The World Health Organization (2018) emphasizes that concerns regarding overweight and obesity are directly linked to unhealthy eating habits acquired during young adulthood. Consequently, understanding eating behavior during this transitional period is crucial, particularly among overweight and obese individuals. While numerous studies have explored eating behavior among university students in Malaysia, there remains a gap in exclusive examination. For instance, a study by Muhammad et al. (2023) investigated intuitive eating behavior among this population and found a potential correlation with decreased prevalence of obesity and unhealthy eating.

Studies involving Malaysian youth, encompassing the same age groups as the present study, have identified various factors influencing eating behavior. These factors include demographics such as age gender, ethnicity, marital status, education level, household income, religion, and locality. Gender emerges as a widely studied demographic factor impacting youths' eating behavior. With few exceptions, gender is associated with all dimensions of eating behavior, with males being more susceptible to eating behavior problems, leading to concerns regarding overnutrition and undernutrition (Tan et al., 2019). This is further supported by males'

higher intake of calories and energy levels, which could contribute to overweight or obesity (Palaniveloo et al., 2021). Additionally, Malay males exhibit the highest preference for salt, contributing to a higher association with hypertension (Marina et al., 2019; Liew et al., 2019). However, males are also associated with healthy eating habits such as higher vegetable intake (Rohin et al., 2021). Therefore, this could explain the higher prevalence of overweight and obesity among the male university students. Conversely, females demonstrate a higher prevalence of fast-food consumption (Cheong et al., 2021) and are more prone to eating disorders such as binge eating and higher fat percentage, increasing the risk of cardiovascular diseases (Gan et al., 2018; Thangiah et al., 2021).

During the COVID-19 pandemic, a study revealed that 22.4% of students were emotional eaters, 58.6% were external eaters, and 23.0% were restrained eaters (Nur Islami et al., 2024), indicating prevalent unhealthy eating behaviors. Disordered eating is widespread among Malaysian university students, with a higher prevalence among females than males (Chin et al., 2020). Factors such as depressive symptoms, body size satisfaction, and body appreciation play a role in predicting disordered eating in females, underscoring the importance of interventions, especially behavioral interventions, to address this issue. This could be linked to weight-related difficulties and unhealthy eating behavior among university students. Thus, there is a pressing need to examine eating behavior through behavioral interventions within this population.

2.4 Psychological flexibility as a mechanism of change in ACT

ACT is a therapeutic approach that focuses on negative human language and cognition in order to create psychological flexibility. It is rooted in functional contextual philosophy (Biglan & Hayes, 1996; Hayes et al., 1993) and theoretically rooted in the framework of the

relational frame theory (RFT) (Ruiz, 2010). RFT is a vigorous and comprehensive experimental analysis of human language and cognition (Hayes et al., 2001a). Its emphasis is on context, distinguishing between contexts that establish cognitive networks and those that determine the specific functions of these networks. ACT aims to change the cognitions, emotions, memories, and bodily sensations to a context that increases their functional importance the similar efforts with its root, the RFT.

2.4.1 Relational Frame Theory

The RFT, which aims to provide a modern behavioral perspective on human language and cognition, serves as the theoretical basis for the ACT model (Hayes et al., 2001). A key principle of RFT is that human behavior is largely influenced by relational frames, or mutual networks. Humans are capable of subjectively relating any environmental object, thought, memory, emotion, behavior, or bodily experience to any other of these in literally any way. Using relational framing, individuals are capable of envisioning the future, learning from the past, retaining information, and assessing (Hayes et al., 1999). It is considered that relational frameworks may lead to psychological suffering (Tull et al., 2004). The learned relational frame would influence future behavior, and this would be hard to alter, according to RFT (Hayes et al., 2004). This demonstrates that learning healthy behaviors, such as eating healthy or leading an active lifestyle, has the potential to be sustained if an individual is able to learn from the past, apply what he/she has learned, and evaluate his/her actions.

Through relational framing, individuals can withdraw their behavior from the direct influence of circumstances and replace it under the command of verbal rules (social, cultural, familiar, and similar conventions)—what works in the present moment in the service of what someone values. RFT implies that the natural verbal mechanisms that allow fragile beings like

humans to command their entire environment are the same processes that can cause their behavior to be extremely confined, rigid, maintained, and governed by socially constructed verbal rules rather than their immediate effects (Hayes et al., 2006). Body weight issues exist in the normal operations of human language processes (such as problem solving) when those processes are applied to solve internal experiences (e.g., negative thoughts, emotions, memories, physical sensations, etc.) rather than problematic situations or events in the external environment world resulting in experiential avoidance (Hayes, 2005; Hayes et al., 1999).

Enhancing psychological flexibility is the ultimate aim of ACT. It fosters embracing and welcoming one's own internal experiences without judging them (Hayes et al., 2011). By addressing the six interconnected processes that make up the Hexaflex model (Figure 2.1), this is facilitated.

2.4.2 Six core ACT processes

ACT aims to improve psychological flexibility by changing the context of uncomfortable private events which usually deal with occasions of experiential avoidance. Psychological flexibility is the ability to contact the present moment more fully as a conscious human being, and to change or persist in behavior when doing so serves valued ends (Hayes et al., 2004). These are the six cores of the ACT processes:

1. Acceptance

Acceptance involves actively embracing inner experiences while they are presently occurring as ongoing inner experiences. Instead of being an attitude or a viewpoint, this is an action. Either we can try to control our inner experiences, or we can choose to respond in an embracing manner. It focuses on the inner experience and reduces the effort made to govern or

control certain internal experiences. When one tries to diminish or avoid unwelcome inner experiences since doing so has a detrimental impact on how they function, that is called experiential avoidance, and acceptance is used to counteract that avoidance (Hayes et al., 1996). An example of experiential avoidance includes an individual with body weight issue to avoid or escape situations that bring on diet or exercise or avoid being weighed in public or while in discussion about body weight. Acceptance will involve actively being in situations that bring discomfort of body weight issues but treating one's body weight issue in a welcoming way while it is there. Thus, in exposure exercises, the therapy should involve asking, "How open are you with your body weight?", rather than "How much do you feel about your body weight?"

2. Cognitive defusion

This entails changing the context in which inner experience takes place in an effort to lessen its automatic impact and relevance and enable us to view it as an ongoing process. In other words, cognitive defusion is a method to adjust the inner experience by convincing oneself that the feeling is just a feeling, thoughts are just thoughts, and the individual has power on his own actions. Cognitive defusion can be achieved by evaluating thoughts for what they actually are rather than what they purport to be. For instance, one should assist someone who believes "I am fat" to see it as a product of their own thinking rather than self-evident real facts (Ruiz, 2010). This is especially important to keep in mind for people who frequently have negative thoughts about their weight, which, in turn, heighten the likelihood of having negative feelings and increase the likelihood of overeating. Techniques that are helpful for cognitive defusion include verbalizing the thought in the following format: "I am having the thought..." in order to reduce the influence of the thought. In addition, cognitive defusion may lessen cognitive rigidity, especially with regard to diet-related concerns. This may decrease the chance of future

overeating episodes and stop the vicious cycle of restriction accompanied by overeating (Palmeira et al., 2017)

3. Self as context

This is the self-concept based on self-evaluations and categorizations. It represents who we think we are. Clinically, the problem is that even when doing so results in ineffective conduct, people nevertheless make an effort to preserve, protect, or shelter that conception of themselves. For instance, if a person labels himself or herself as "stressed," he or she may continue acting in that way even though it may be harmful to him or her. By using ACT, this therapy will help individuals establish a sense of their "selves" as a context, where the self is the point of awareness or perspective-taking that enables them to experience both internal and external events from "I/her/now" without letting those events define them. By beginning with this sense of self as context where inner experience occurs but is not defined by them, we can choose to follow and conform to our senses of who we are in situations and not in others. It is preferred that this area be flexible. Applying cognitive defusion to one's conception of oneself and engaging in mindfulness or other awareness activities are thought to help.

4. Being present

It is the state in which we are flexible, fluid, and voluntarily focused on internal and external events as they occur, without evaluation or judgement. It helps in experiencing the world as it is. An example of not being present is when the individual is worried about being in contact with events that have already occurred or might occur.

Being present, or present moment awareness, is the process of becoming acquainted with the sensory experiences of the present moment through engaging in more mindful actions

(Hayes et al., 2016). This can help raise awareness of automated cognitive processes that may result in unwanted behaviors that provide a brief reprieve but still have long-term negative consequences (Hayes et al., 2016). A lack of awareness regarding one's food choices frequently results in mindless eating to satisfy internal cues in the context of overeating (Haynos et al., 2016). As many of these decision-making processes operate implicitly and knowledge is only acquired after the fact, this makes it particularly challenging to change behavior. This may cause feelings of guilt in obese persons or sustain the negative effect that may have contributed to their poor eating habits. Thus, ACT promotes the conscious use of psychological skills, such as mindfulness, that minimise one's sensitivity to temporary negative internal experiences (Forman et al., 2009). These abilities enable people to function independently of their unpleasant emotional experiences and encourage continued self-regulation (Hayes et al., 2016).

5. Values

In ACT, values are aspects of life that matter to us and inspire us to engage in certain behaviors. Goals and values are frequently compared. We can achieve our goals, like getting married. Only as a component of ongoing behavior, like being a loving and kind husband, can values be realized. They can be sought throughout one's life, yet they are not objects that can be owned. They can give our actions direction, meaning, and purpose. Thus, identifying one’s values should help make it more likely that he or she will approach stimuli that foster avoidance. For example, telling a person, who is overweight, has a self-confidence issue, and always projects out when dealing with his health, to be brave enough to attend a health center for exercising or conducting a medical check-up would increase the reinforcing value of experiencing those issues.

Clarifying one's values is necessary for committed action, and moving toward treasured goals requires accepting uncomfortable feelings and thoughts in the process (Hayes et al., 2011). As motivation to engage in weight management behaviors declines with time, self-determined value-based goals are required to survive these motivation deficits, accept internal discomfort, and maintain long-term committed action. As a result, ACT emphasizes the value of clarity by encouraging people to carefully consider the meaning of their behavior in a range of life domains (Weineland et al., 2012).

6. Committed action

This is where traditional behavior is incorporated into therapy. This action is more skill-based and typically entails living out one's values while exercising acceptance, diffusion, being present, and treating oneself as the setting for inner experience. Committed action is the ongoing redirection of behavior in order to build broader patterns of flexible and effective behavior that are related to a value. It entails setting individual goals along a path, pursuing those goals while using the other ACT techniques, and establishing wider patterns of values-based behavior.

The Hexaflex (Figure 2.1) shows how all processes are interconnected; in practice, movement to one ACT process usually always result in changes to one or more additional ACT processes (Hayes et al., 2006). The left side of the Hexaflex represents processes of mindfulness and acceptance (i.e., acceptance, defusion, contact with the present moment, and self as a context), whereas the right side represents processes of behavior change and commitment (i.e., values, committed action, contact with the present moment, and self as a context).

Nevertheless, the ACT maintains that excessive cognitive fusion and experiential avoidance contribute to psychological inflexibility (Figure 2.2). Psychological inflexibility is characterized as the rigid dominance of psychological reactions over set values and

circumstances in driving action (Hayes et al., 2006). This type of behavior often arises when people want to avoid experiencing undesirable internal occurrences. There are four key concepts in the ACT model of psychopathology: fusion, evaluation, avoidance and reason giving (Hayes et al., 1999). Cognitive fusion refers to situations where behaviors are excessively regulated by verbal rules and indirectly by experiences. For example, a verbal statement, "I am fat", is not experienced merely as a private verbal event but rather as a true state of being. A person may think, "If I eat this cake, I can't fit the dress," which could lead to bulimic incidents or an excess of self-doubt, and eventually unhealthy eating practices.

Fusion can specifically result in experiential avoidance when a person is unable to maintain contact with unpleasant personal occurrences. Any attempt to change the nature, regularity, or sensitivity of personal occurrences, even when doing so harms others, is known as experiential avoidance (Hayes et al., 1996). This would negatively cause individuals who experience this to disconnect from the present or actual moment. The attempt to occasionally avoid uncomfortable events can eventually limit an individual ability's to be flexible with their psychological thoughts.

Verbal evaluation strengthens the link between fusion and avoidance. Humans evaluate most of their experiences in relation to fear of or wish for events. Thus, any event can function as positive or negative. A person who wishes to have a slimmer body would be unhappy because she or he could not fit into his or her favorite outfit.

Finally, reason-giving draws a person's useless attempts to understand and explain as a method for controlling outcomes (Hayes, 2002). Some individuals with body weight issues would give reasons why they were not able to lose weight or practice a healthy lifestyle because they believed the condition could not be altered because it was part of their genetic makeup,

and they must accept who they are. This type of reason frequently has a negative impact on people's behavior. They would believe that their body weight problem was something they had to accept and that there was nothing they could do about it.

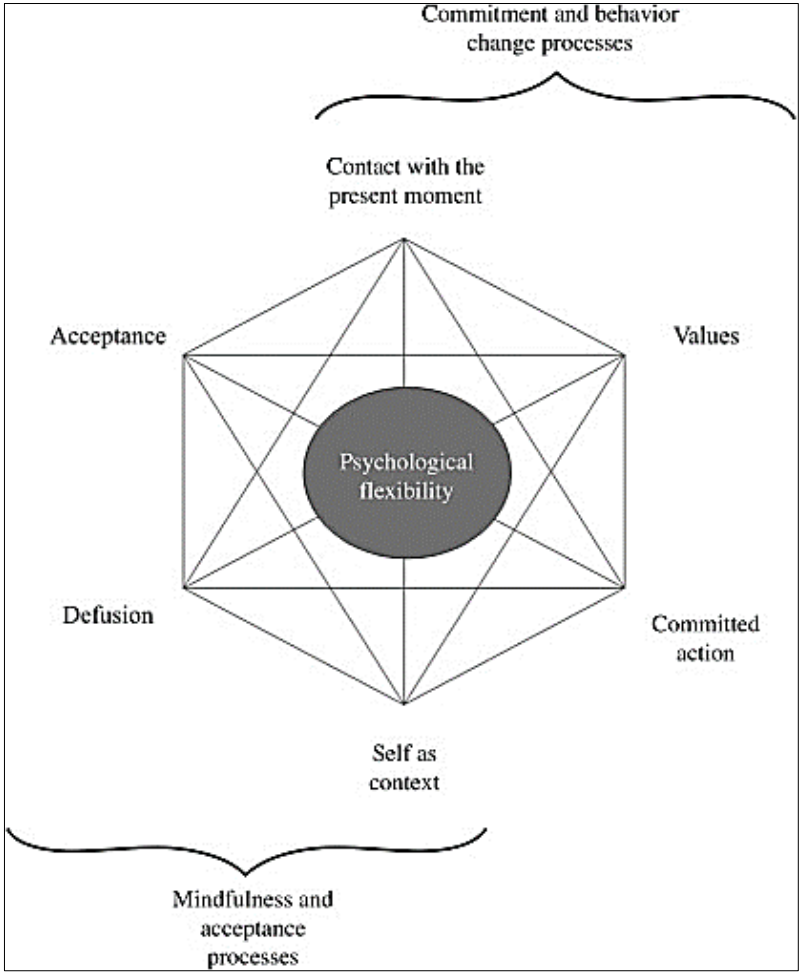


Figure 2.1: The ACT Hexaflex

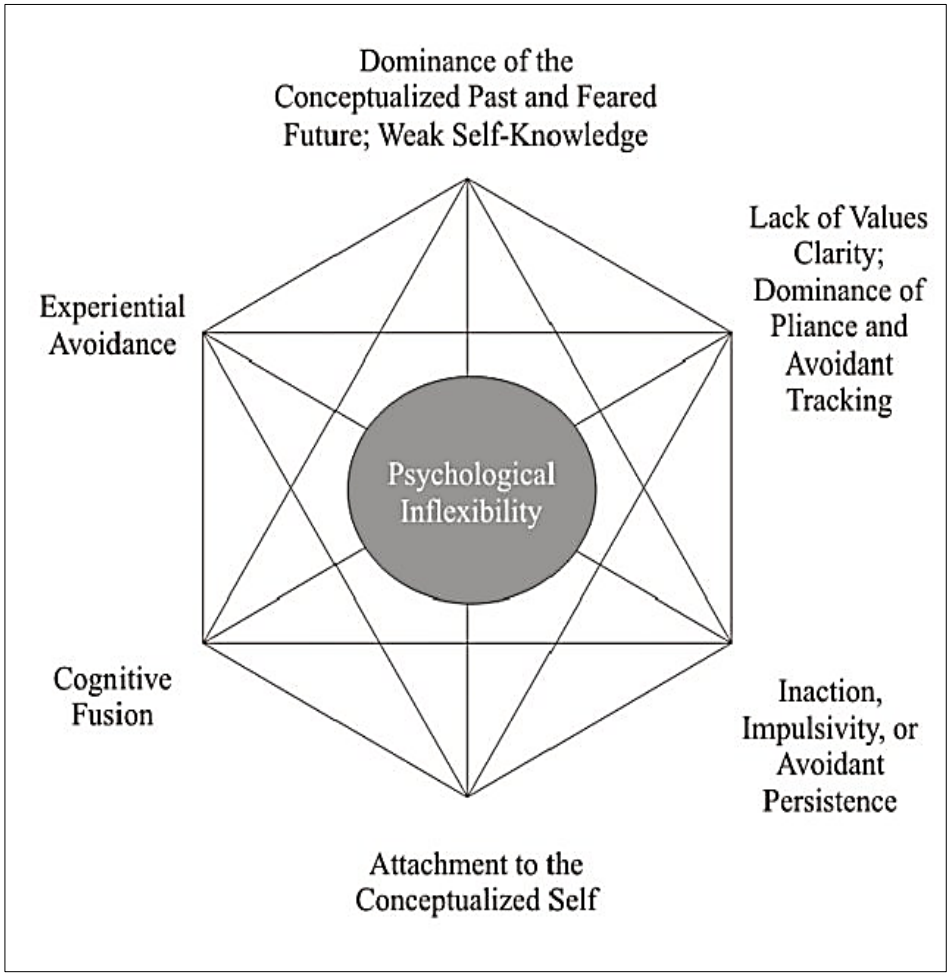


Figure 2.2: The Psychological Inflexibility

2.5 Acceptance Commitment Therapy and Weight-Related Difficulties in Overweight and Obese Adults

Experiential avoidance is suggested as a barrier to weight control based on earlier studies (Hooper et al., 2012; Lillis et al., 2009), making it logical to assume that it is toxic to weight control. The ACT employs acceptance, mindfulness, and values processes to produce psychological flexibility or the willingness to act in accordance with one's values in the presence of unwanted thoughts, feelings, and bodily sensations. ACT aims to foster healthy behavioral patterns aligned with stated values while teaching mindfulness and acceptance skills to improve behavioral commitment to values-based behavior in the context of weight management (Lillis & Kendra, 2014).

The use of ACT approaches to address weight-related concerns and physical activity has empirical evidence (Butryn et al., 2011), which is almost similar to the present study. Since the focus of this study is on weight, the studies on ACT intervention and weight-related difficulties are reviewed in depth to understand the gist and the need of present study. Seven studies have been identified which had the following criteria: a) adopted an RCT design, b) used ACT as intervention, c) conducted on adult participants (age over 18 years) with BMI over 25kg/m^2, and d) included BMI and weight and weight-related difficulties (using the AAQW instrument) as outcome measures.

Potts et al. (2022) included 55 OW/OB participants with high weight-related self-stigma. They were allocated at random to one of the three groups: the ACT self-help book plus phone coaching group (GSH-P), the ACT self-help book plus email prompts only group (GSH-E), or a waitlist condition (CG). Online self-report assessments and post-intervention measurements were conducted eight weeks later. Both intervention groups had decreased

weight-related difficulties at the post-intervention, but not the CG. Changes within groups from pre- to post-intervention had a large effect size. However, BMI was not significantly different within the ACT condition (-7.12% in GSH-P vs. -5.82% in GSH-E), similar to the other outcomes of emotional eating and physical activity. The decrease in BMI measurement from pre- to post-intervention should be noted in both ACT conditions. Therefore, the phone coaching and email approach ought to be beneficial in delivering ACT interventions for health behaviors.

Lillis et al. (2021) recruited 102 (mean BMI = 34.4, *SD* = 4.3, mean age = 57.8, *SD* = 8.9; *n* = 31 males, *n* = 71 females) participants who received a 12-week online weight loss intervention and lost > 5% to a one-day, five-hour workshop based on ACT, Self-Regulation (SR) or no workshop (CG) with three months of limited email follow-up. Weight loss was significant within the ACT group at every follow-up time ($p < .05$). At the end of the 24-month study, the overall weight loss was greater in the ACT group (-7.18%) than in the SR group (-4.18%) and control group (-1.15%). However, comparing between ACT group and the SR group, and SR group and CG, the weight loss were not significant ($p > .05$). There was significant difference in weight loss between the ACT and CGs ($p < .05$) at 24 months. Similar results were revealed in weight-related difficulties. All three groups showed marked decreases, but no significant differences were noted.

One study utilised *N* = 88 veterans aged 18 to 75 years (mean age = 57.3 ± 9.9, mean BMI = 37.2 kg/m^2 ± 7.0) who completed *MOVE!* program (Afari et al., 2019). *MOVE!* is a weight management and health promotion program designed to improve the lives of veterans. Its core ideas are to encourage healthy eating behavior, increase physical activity, and promote even small weight losses. The participants were randomized to four two-hour weekly ACT

sessions or a continued behavioral weight loss intervention (BWL). Both groups exhibited a reduced in AAQW score at post-intervention, at three-month and at the six-month follow-up. The decreased in AAQW score meant that they became more psychologically flexible regarding their weight. It also indicated that they could perform value-based actions in the presence of undesirable thinking patterns, emotions and physical sensations (Lillis & Kendra, 2014). There was a weight reduction in both groups until the three-month follow-up. However, they both reverted to the baseline level at the six-month follow-up. The information of how many percent of weight loss of these participants after participating in *MOVE!* program was the limitation of this study. Even so, the gradual reduction in AAQW score indicated a promising flexibility in terms of their psychology regarding weight-related issues.

Another study measuring the effectiveness of Acceptance-Based Behavioral Intervention-ABBI (ACT) compared to the Standard Behavioral treatment-SBT (non-ACT) examined process variables that might contribute to the observed differences in weight change (Lillis et al., 2017). Participants were N = 162 adults with overweight or obesity (mean BMI 37.6 ± 5.35 kg/m^2, mean age = 50.25 ± 11.0 years), and reported elevated levels of internal disinhibition (defined as a score of five or higher for women or four or higher for men on the Internal Disinhibition subscale of the Eating Inventory (Stunkard & Messick, 1985) were randomly assigned to ABBI or SBT. The ABBI included the traditional weight loss strategies along with the ACT intervention. On the other hand, the SBT utilized cognitive strategies to address negative thoughts, emotion and food cravings that may impede weight loss. There were 32 intervention sessions in the span of one year. Both groups improved in AAQW score across 24 months, with no significant difference between groups. However, weight loss was greater in ACT group (- 4.2%) than the non-ACT (-2.4%) from baseline to 24-month. With regard to internal disinhibition, there were strong correlations with weight change for both conditions

during both the intervention and post-intervention phases, suggesting that those who made the largest changes in internal disinhibition on average lost more weight. Conclusively, targeting those with high internal disinhibition for weight loss is promising based on the findings of this study.

A study involved N = 73 women with OW/OB (mean BMI = 34.24 ± 5.04 kg/m^2, aged 18 to 55, mean age = 42.35 ± 8.79 years) who joined a nutritional treatment for weight loss on primary care units and hospitals, were randomly allocated to either Kg-Free plus Treatment-As-Usual (TAU) (ACT group) or control group (non-ACT group) (Palmeira et al., 2017). Kg-Free was a manualized group intervention based on mindfulness, ACT, and compassion-based approaches. On the other hand, the TAU included a physical examination and addressing comorbidities. There were nutritional appointments, where they were weighed, received tailored dietary recommendations (according to one's needs and food preferences) and physical activity prescriptions (at least three times per week of moderate to high intensity physical exercise are usually recommended). No psychological intervention was involved in TAU. The results revealed that the ACT group had a substantial decrease in AAQW score and BMI in comparison to the control group at 12 weeks post-intervention. Other outcome measures, weight self-stigma, health quality of life, eating behaviors, self-criticism, and psychopathological symptoms, also showed improvement in this study. Consequently, Kg-Free intervention proved to be very promising. Element of physical exercise that was recommended might contribute to the improvements, especially in BMI.

In another study, which also involved N = 149 women (aged 25 to 60 years, mean age = 49.5 ± 7.4 years, mean BMI = 31.3 ± 2.9 kg/m^2) who had reported symptoms of perceived psychological stress were recruited for an eight-week intervention (Sairanen et al., 2017). The

participants were randomly divided into ACT face-to-face intervention group, ACT mobile intervention group and non-treatment control group. The ACT face-to-face group intervention comprised of six group sessions throughout eight weeks, with a 90-minute duration for every session. In contrast, the participants in the ACT mobile intervention were provided with smartphones pre-installed with a stand-alone mental wellness training application. The participants practiced the ACT training module on their own, which contained similar ACT-based intervention programs as the face-to-face session for eight weeks. The control group received no interventions. The face-to-face ACT and the mobile ACT application's outcome measures were combined as one. As for the results, the ACT groups showed an increased in weight-related psychological flexibility (AAQW score reduced) regardless of the type of ACT interventions. The mediation analysis showed that the effect of the intervention on weight was mediated by the decrease in AAQW score. However, there was no significant improvement in the general psychological flexibility (measured by the Acceptance and Action Questionnaire – II - AAQ-II) and BMI post-intervention, and between groups. Even though this study was targeting those with overweight and obese participants, the ACT interventions did not affect their BMI. The ACT interventions influenced the individuals' ability to continue with the valued activities even when confronted with negative emotions and thoughts related to weight, possibly explaining why they were improving in the AAQW score, but not in the weighing scale.

A brief duration of ACT in improving AAQW score has been tested in a recent study (Lillis et al., 2021) and also in the author's earlier study (Lillis et al., 2009). Lillis et al. (2021) recruited 102 (mean BMI = 34.4 kg/m^2, *SD* = 4.3, mean age = 57.8, *SD* = 8.9; *n* = 31 males, *n* = 71 females) participants who received a 12-week online weight loss intervention and lost > 5% to a one-day, five-hour workshop based on ACT, Self-Regulation (SR) or no workshop

(control) with three months of limited email follow-up. Weight loss was significant within the ACT group at every follow-up time ($p < .05$). At the end of the 24-month study, the overall weight loss was greater in the ACT group (-7.18%) than in the SR group (-4.18%) and control group (-1.15%). However, comparing between ACT group and the SR group, the weight loss was not significant. There were significant differences in weight loss between the ACT and control groups, and the SR group and control group at 24 months ($p < .05$). Similar results were revealed in weight-related difficulties. All three groups showed marked decreases, but no significant differences were noted.

The earlier study reported a promising result, especially on weight loss after attending a one-day ACT workshop (Lillis et al., 2009). They included obese patients (mean BMI = 33.04 kg/m^2, *SD* = 7.15, male, *n* = 8; female, *n* = 76; aged above 18 (mean age = 50.25, *SD* = 11.25) who had completed at least six months of any structured weight loss program in the past two years in US (*N* = 84). They were recruited from the local weight loss clinic and through flyers and advertisements in the local newspapers. Participants (*n* = 43) who were randomly assigned to ACT underwent a one-day, six-hour ACT workshop. The CG (*n* = 40) received no intervention. Follow-up at three months revealed that weight-related difficulties and weight (ACT: -1.17% vs CG: + 0.06%) decreased significantly in the ACT group than CG ($p < .05$). Except for breath holding ($p > .05$), other measured outcomes (psychological stress, quality of life, weight-related stigma) showed significant differences between groups ($p < .05$). The mediation analysis indicated that improvements in weight-related flexibility and weight loss were mediated by ACT—weight-specific acceptance coping and psychological flexibility. This study demonstrated the potential of ACT for weight-related issues and weight loss among the obese.

Even though the intervention took one-day, the effects were observed in the outcome measured. None of the content in the workshop or materials given to the participants contained strategies for weight loss. The workshop was presented to the participants to live a more fulfilling life consistent with their chosen values. What was highlighted in the study was that the BMI loss was greater in ACT participants compared to the control group. This indicated that the efforts to control weight were enhanced without any focus on weight control. This study demonstrated the potential of ACT for weight-related issues and weight loss among the obese. This was similar to a study that examined a one-day of two-hour ACT workshop which involved a group of women who were trying to lose weight (Tapper et al., 2009). Similar results were observed: at the follow-up after six months, the participants in the intervention group reduced a significant amount of body weight compared to the CG who received no ACT. Interestingly, the weight loss intervention was also not taught in the ACT workshop.

2.6 Earlier Studies of ACT among the Overweight and Obese Participants

In an earlier study, measuring the effectiveness of ACT involved overweight and obese women aged 25 to 55 years (Lillis & Hayes, 2008). They were assigned to either the ACT group or the CG for eight sessions over the span of two months. The results showed that those receiving ACT improved more in psychological flexibility than those receiving CG. The increase in psychological flexibility among the participants was agreed to be related to the way they dealt with their avoidance experiences, inducing more flexible and healthier behaviors. They were assigned to either the ACT group or the CG for eight sessions over the span of two months. The results showed that those receiving ACT improved more in psychological flexibility than those receiving CG. The increase in psychological flexibility among the participants was agreed to be related to the way they dealt with their avoidance experiences,

inducing more flexible and healthier behaviors. However, this study had several weaknesses. It did not measure the changes in the participants' BMI post-intervention. The authors maintained that the value of ACT was to aim for a healthy lifestyle instead of weight reduction. It would be interesting to examine whether the intervention contributed to any changes in body weight after the intervention. This warrants further study, which should measure the BMI changes post-intervention to explore the full potential of ACT. Fortunately, this has been improved by many studies. Plenty of findings and more insightful ACT interventions were discovered in terms of the overweight and obese population.

A seven-hour workshop of ACT intervention did improve the AAQW score and reduced BMI at the three-month follow-up (De Freitas et al., 2017). The participants were 56 women participants (aged 18 to 59 years, mean age = 44.7 ± 11.1 years) who were overweight or obese (mean BMI = 31.35 ± 3.63 kg/m^2). They were classified into binge eating severity categories: no symptom of binge eating, moderate binge eating, and severe binge eating. The ACT intervention was based on two earlier studies (Lillis & Hayes, 2008; Lillis et al., 2017). All groups displayed a reduction in AAQW score and BMI at the three-month follow-up. The MS group achieved a substantial decrease in BMI. Moreover, there was a reduction in the percentage of participants classified as obese. There was one major limitation of this study: it did not measure the binge eating score at post-intervention and follow-up. Even though this study did not have a control group, and had a short duration of intervention, the sustainability of the AAQW score and weight loss was promising at the follow-up.

Overweight and obese adults (N = 283, aged 18 to 70 years, mean age = 53.28 ± 9.62, mean BMI = 35.21 ± 4.9 kg/m^2) from a community were recruited for a 12-month study (Schumacher et al., 2019). There were three group-based intervention conditions: standard

behavioral treatment (non-ACT), behavioral treatment augmented with specialised skills for addressing the obesogenic environment (non-ACT), and behavioral treatment with environmental and acceptance-based skills (ACT). All groups met for 26, 75-minute sessions over 12 months, with once-a-week session for the first four months, biweekly for five to six months, and monthly in month seven to 12. The outcome measures were done at month six and at the end of month 12. The results revealed that all participants in general, had a moderate psychological flexibility (measured by using the Acceptance and Action Questionnaire-II-AAQ-II), which meant an acceptable psychological flexibility. Weight loss was also observed in all groups, with no significant difference between the groups. This study was interesting since it measured the food-related (measured by Food-Related Psychological Flexibility – FAAQ) and physical activity-related psychological flexibility (measured by Physical Activity Acceptance Questionnaire-PAAQ), and both improved in ACT group. The only weakness of this study was not using AAQW to measure the weight-related psychological flexibility. As a result, little can be discovered in term of weight-related issue from the ACT intervention.

An exploratory single-group design with 29 overweight or obese people also revealed the effectiveness of ACT principles in enhancing weight-loss behaviors (Forman et al., 2009). An established 12-week behavioral weight loss strategy was augmented with acceptance-based techniques like mindfulness, distress tolerance training, and commitment development (Fairburn & Brownell, 2005). Participants evaluated acceptance-based strategies for improving adherence to weight control behaviors, such as "urge surfing" (observing eating urges from a distance) and cognitive defusion. From baseline to post-intervention, changes in ACT-related variables such as motivation, experiential avoidance, emotional eating, and mindfulness were seen. These changes, in turn, were attributed to weight loss at post-intervention and at the six-month follow-up.

These were the earliest studies of ACT and weight loss/weight management among the OW/OB participants. The studies are growing till today, however, it is still lacking many elements; which are the attempt of this thesis: to evaluate the changes of WRF, eating behaviors and defense styles among the overweight and obese population with the inclusion of a structured exercise program.

2.7 ACT and Physical Activity

Promoting physical activity by implementing ACT was supported (Butryn et al., 2011). The study involved female college students in a four-session ACT workshop. There were two interventions compared, which were ACT and Education intervention in promoting physical activity. Both interventions provided information about physical activities. Specifically, in the Education intervention, the participants discussed the benefits of health-related fitness and how to incorporate those components in their workouts. Meanwhile, in the ACT, the participants were helped to develop willingness skills, to become more mindful, to defuse themselves from distressing thoughts about exercise, and to strengthen their commitment to exercise-related values. Experiential and metaphorical exercises were used to maximize engagement and understanding. The measures were conducted at the first week and in week five for post-intervention. A follow-up was also conducted at week eight. As expected, physical activity was significantly greater among the ACT group than the Education intervention. The study suggested that the participants were willing to engage in physical activity, to accept the internal experience (tired, hot, bored) and to psychologically step back from experience (defusion). Amusingly, defusion decreased among the Education intervention group, indicating that it could be effective for brief exercise interventions. The participants might increase their exercise frequency even if they had uncomfortable thoughts and feelings. This study supported the ACT in the treatment for obesity, in parallel with previous studies (Forman et al., 2009; Lillis et al.,

2009; Tapper et al., 2009), thus strengthening the incorporation of this therapy as an intervention in this proposed study.

2.8 Defense Mechanism

A defense mechanism is defined as the ways and means by which the ego wards off unpleasure and anxiety, and exercises control over impulsive behavior, affect and instinctive urges (Freud, 1966). In addition, defense mechanisms are unconscious reactions to events which elicit anxiety (Juni, 1999). They serve to alter an individual's perspective of an event and resolve internal conflict without changing the event itself (Cramer, 2006). There are three levels of the hierarchy of defenses: the immature, intermediate and mature (Vaillant, 1971). The immature defense is mostly among youngsters, and it is characterized by projection and acting out, while intermediate defense, such as repression, displacement and reaction formation is more common among individuals with neurotic disorders. The healthier people would be more likely to be in mature defense, with the individuals using altruism and humour to ward off the unpleased event. A study which conducted a 30-year follow-up of 30 men for psychological health found out that most of these adults were using a coping and defensive type of ego mechanisms (Vaillant, 1971).

The study on defense styles has become an interest in how it relates to the physical health of the general population. In a study, exploring the relationship between personality traits and defense styles with BMI among high school female students (Alipour et al., 2016) has shown that neurotic defense style had a significant relationship with BMI. The greater the neurotic style was used as a defense, the higher the students' BMI. The other defense styles, altruism (mature), displacement (immature), humour (mature) and undoing (immature) were associated with BMI. The youngsters as supported (Vaillant, 1971a) were using some immature

style to deal with their BMI although some mature defense styles were used too. Most female adolescents are struggling with their body weight and the defense styles are selected as how they combat with the anxiety from the unpleasing body weight.

It was suggested that the combination of neurotic and immature defense styles may lead to eating disorder and unhealthy BMI (Pour et al., 2011). This could be an interesting issue to raise in the proposed study. Neurotic style is where an individual uses false altruism, reaction formation, idealization and undoing (Besharat, 2009) while the immature defense is where an individual uses rationalization, projection, denial, displacement, and isolation as a way of coping their unpleasant feeling. Being overweight would likely to be unpleasant to anyone, especially those who are concerned more on their look. This is most likely to be among females. Overeating or binge eating as one of the eating disorders is used as a biological moderating mechanism to regulate, create and avoid negative impacts or deal with uncomfortable events (Pour et al., 2011). This could explain the relationship between eating behavior and BMI, and the defense style (immature or neurotic) used to regulate the unwanted event of gaining extra weight.

One qualitative study conducted (Faden et al., 2013) on a female subject who was extremely obese, found that becoming obese was the way she handled her insecurity. This subject has undergone gastric bypass surgery and was reported to become insecure of losing her weight as she gained weight in her early teenage years up to the present (she was a 37-year-old married woman) as a defense to ward off sexual advances. She was sexually abused in her teenage years; thus, she gained weight to fight the unpleasant event that remained in her memory. Gaining weight might be from excess eating or emotional eating (Kristanto et al., 2016).

The prevalence of defense mechanism among the obese population in the management of weight was studied (Zoccali et al., 2008). The study assessed 70 obese outpatients from a hospital in Messina, Italy on five major groups of defense mechanisms: turning against object, projection, principalization, turning against self, and reversal. These mechanisms were significantly greater among normal weight subjects in comparison with the obese subjects except for principalization. However, obese males were significantly higher in turning against object and projection compared to obese females. Those two defense styles are in the category of immature. Thus, this study indicated that there was a gender difference in the type of defense mechanisms utilized in dealing with their weight condition. Treatment of obesity was suggested in further assessing the defense mechanism among the overweight and obese population.

2.9 Summary

Tackling the overweight and obese phenomena and eating behavior are of great interest. Integrating behavioral treatment, the ACT, into the intervention of body weight management among OW/OB people may provide additional indicators to consider in the context of multidisciplinary treatment for these two problems, which includes educational and psychotherapeutic programs. There is no study of ACT yet that has included a structured exercise program in the intervention for weight loss. Because of the lack in established relationships between these variables, the proposed study aimed to measure the effectiveness of ACT and ACT combined with structured exercise program on the weight-related psychological flexibility and eating behavior of the overweight and obese university students with immature or neurotic defense style. Figure 2.3 illustrates the conceptual framework derived from the literature, outlining the consequences of OW/OB in weight-related psychological difficulties, unhealthy eating, and maladaptive defense styles, as well as the potential improvements due to the inclusion of ACT intervention and exercise intervention.

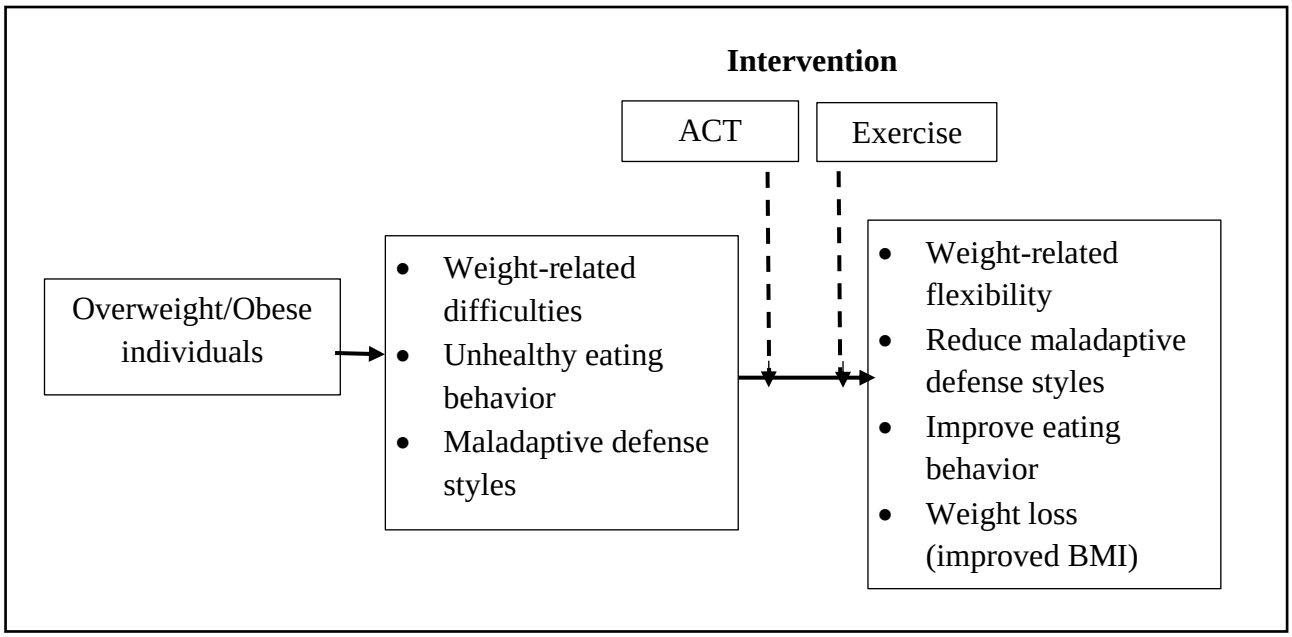


Figure 2.3: The conceptual framework of OW/OB, with its consequences in weight-related psychological difficulties, unhealthy eating, and maladaptive defense styles, and the potential improvements due to the inclusion of ACT intervention and exercise intervention.

CHAPTER 3

METHODOLOGY

3.1 Overview

This chapter presents the research design, population, sampling, instrument for data collection and method of data analysis. This study was divided into two phases. The first phase was surveying the rate of OW/OB and all related variables, whereas the second phase was the intervention programme utilizing ACT to reduce BMI, improve WRF and eating behavior among the immature and neurotic defense styles participants.

3.2 Phase 1

3.2.1 Research Design for Phase 1

The first phase of the study is a cross-sectional research design in which the prevalence of overweight and obesity among university students was obtained. The data collection was conducted from March to November 2020 during the COVID-19 pandemic and restriction movement controlled order (RMCO).

3.2.2 Participants

There were 622 participants who were enrolled in associate and bachelor's degree programmes from two public universities in Sarawak, Universiti Malaysia Sarawak (UNIMAS) and Universiti Teknologi MARA Sarawak participated in the first phase. Their aged between 18 and 24 years old. Each participant volunteered to take part in the study.

The sample size was calculated using the Krejcie and Morgan technique (Krejcie & Morgan, 1970), with a 5% margin of error (e) and a 95% confidence level, as shown in Figure 3.1. The total population size consisted of 21,584 students from both universities (UiTM Sarawak had 8,063, while UNIMAS had 13,521 as of 2020). Consequently, the minimum

sample size for this study was determined to be 377 respondents. This calculation was performed using the formula;

n = [21584×0.5×(1−0.5)] / [$(0.05)^2$+(21584−1)×0.5×(1−0.5)]

= [21584×0.25] / 0.0025+21583×0.25

n = 5396 / [0.0025+5395×0.25]

n = 5396 / [0.0025+1348.75]

n = 5396 / 1348.7525

$n \approx 377.19$

n = 377.

This survey yielded 622 responses, with 330 and 292 representing associate and bachelor's degree students, respectively. Thus, it represents the population of university students from both campuses.

$$n = \frac{\chi^2 Np(1-p)}{e^2(N-1) + \chi^2 p(1-p)}$$

- n = sample size
- N = population size
- e = acceptable sampling error
- χ^2 = chi-square of degree of freedom 1 and confidence 95%
  = 3.841
- p = proportion of population (if unknown, 0.5)

Figure 3.1: Formula for calculating sample size based on Krejcie and Morgan (1970)

3.2.2.1 Inclusion criteria

Participants were selected using a convenience sampling technique due to stringent regulations during the RMCO and logistical challenges posed by students' limited presence on campus. To be eligible, participants had to be Malaysian citizens and enrolled as full-time students, either in an associate or bachelor's degree program.

3.2.2.2 Exclusion criteria

Pre-university and pre-diploma students, as well as those without internet access during the data collection period, were excluded from the study. This ensured that participants were at an educational level consistent with the study's objectives and could actively participate in the online data collection process

3.2.3 Procedure

Data were collected using an online platform from March to November 2020, when the RMCO was put into effect globally, including in Malaysia. A web-based, anonymous, self-administered questionnaire was uploaded on Google Forms and distributed to eligible respondents using social media sites such as Facebook and WhatsApp. Prior to administering the first survey question, informed consent was sought from the participants. The background and objectives of this study were made available in the first section of the form. They were also briefed on their rights and confidentiality issues in the online form. Information for the second phase of this study was available at the end of the form, which would involve their volunteer participation as well. The nature of the Phase 2 study was also elucidated in the form.

3.2.4 Measures

Body weight. The participants' self-reported weight and height were gathered. For the purpose of weight classification, young adults' self-reported body weight and height data may be utilized to determine BMI (Olfert et al., 2018; Pun et al., 2021; Quick et al., 2015). Thus, the

collected data were deemed reliable for this study's analysis. Individuals' reported weight and height were recorded to the nearest kilogram (kg) and centimeter, respectively. This section offers instructions for weighing oneself at home using bathroom scales, which should be employed to keep bodyweight records whenever possible. Their age (in years), education level, and gender were also recorded.

Body Mass Index (BMI). By dividing body weight (kilograms) by height (meters squared) (kg/m^2), the BMI was calculated. The BMI classification used two references. The first source was taken from the WHO factsheet on overweight and obesity (underweight: < 18.5 kg/m^2, normal weight: 18.5-24.9 kg/m^2, overweight: 25-29.9 kg/m^2, and obese : $\geq$ 30 kg/m^2) (WHO, 2017), while the second reference was according to the Asian classification (underweight: <18.5 kg/m^2, normal weight: 18.5–22.9 kg/m^2, overweight: 23–24.9 kg/m^2, and obese: $\geq$ 25 kg/m^2) (Zainudin et al., 2011).

3.2.5 Statistical Analysis for Phase 1 Study Data

The gathered data were keyed in and analyzed using the Statistical Package for Social Science (SPSS) version 26 software. Descriptive statistics were computed to assess the demographic variables (see Table 3.1 and Figure 3.1). Continuous variables are presented as mean ± standard deviation. Upon comparing the parameters among sexes, study levels, and BMI groups, independent sample t-test and analysis of variance (ANOVA) tests were performed for continuous variables, whereas the Pearson chi-squared test was applied for categorical variables. The effect size for the independent sample t-test, ANOVA, and Pearson chi-square tests was evaluated using Cohen's *d*, partial eta squared (η_p^2), and Cramer's V value, respectively. The magnitude of the effect size was classified as small: 0.20 – 0.50, medium: 0.50 – 0.80 or strong: > 0.80 for Cohen's *d*. The ηp^2 and Cramer's V were classified as follows: No or very weak: 0.00 – 0.04; weak: 0.05 – 0.09; moderate: 0.10 – 0.14; strong: 0.15 – 0.24;

very strong: > 0.25 (Cohen, 2013). The equal variance assumption was satisfied for ANOVA at $p > .05$.

3.3 Phase 2

3.3.1 Research Design for Phase 2

A randomized controlled trial (RCT) design was utilized to investigate the effectiveness of ACT and the combined ACT with structured exercise program on the AAQW score, BMI, eating behavior, and defense style of the overweight or obese university students.

3.3.2 Participants

A total of 152 university students participated in this study. The participants were recruited from two different local universities, and they comprised both female and male students, aged between 18 and 24 years old.

3.3.3 Sampling

Participants were recruited using a purposive sampling technique. This non-probability sampling method involves selecting participants based on specific characteristics relevant to the study, ensuring that each participant provides unique and valuable information (Black, 2010). The inclusion criteria were as follows:

1. Participants were selected based on their BMI, specifically those in the overweight (23.0 kg/m^2 – 27.4 kg/m^2) or obese (>27.5 kg/m^2) categories.
2. Participants did not have any chronic diseases (e.g., hypertension, diabetes) or orthopedic injuries.
3. Participants exhibited greater immature and neurotic defense styles, assessed using the Defense Style Questionnaire (DSQ-40) (Andrews et al., 1993). This criterion is based

on research indicating that a combination of neurotic and immature defense styles can lead to eating disorders and an unhealthy BMI (Pour et al., 2011).

The exclusion criteria were:

1. Individuals currently on medication or with a history of chronic disease.
2. Individuals with orthopedic injuries.
3. Individuals currently participating in a supervised exercise program or psychotherapy.

These criteria were designed to ensure consistency in the baseline characteristics of participants, thereby allowing for more accurate measurement of changes in outcome variables.

The sample size was estimated by following power calculations. Power calculations indicated that 43 participants per condition (assuming an alpha of 0.05, a statistical power, 1-beta of 0.80 and a drop-out of 20% by using G* Power calculation) are required to detect a difference between the three-point measures; baseline, week six and week 12 follow-up. Therefore, a total of 129 participants are suggested. Based on past studies on ACT intervention and weight loss such as Palmeira et al. (Palmeira et al., 2017) (used $n = 27$ and $n = 32$; $N = 59$ for Emotional Eating (EE) and Uncontrolled Eating (UE) and BMI among obese women, respectively), Lillis et al. (2009) ($n = 40$ and $n = 44$; $N = 84$ for weight-related psychological flexibility (WRF) and BMI among obese adults, respectively), and Kohlata et al., (2013) (used $n = 28$ and $n = 29$; $N = 57$ for depressive symptoms), effect sizes were calculated based on power analysis and the effect of 0.5 was expected. Therefore, power analysis calculated by G*Power 3.1 assuming a medium to high effect size and power = 0.8, indicated that a sample size of approximately 50 participants per group (three groups) would be sufficient to execute this study. Thus, a total of $N = 152$ participants recruited were sufficient in the second phase of the study.

3.4 Ethics Permission and Procedure

Both universities granted permission for the study to be conducted. The research proposal was presented to the Medical Ethics Committees, Faculty of Medicine and Health Sciences, UNIMAS. The study protocol was executed following the ICH Good Clinical Practice Guidelines, Malaysia Good Clinical Practice Guidelines, and the Declaration of Helsinki (UNIMAS/NC-21.02/03-02 Jld.4 (02). The ethical permission letter is attached in this thesis (Appendix 1).

In response to a research advertisement at various social media channels (WhatsApp, Facebook and Instagram), the self-identified participants personally contacted the researcher to convey their interest (Appendix 2). The purpose of this advertisement was to inform potential participants about the study's objectives, inclusion criteria, participation requirements, and benefits. Individuals were also given the researcher's contact information so that they could express their interest in participating or learn more about the study.

Before participants agreed to participate, the aims of the study and the requirements for participation were informed. Both aims of the study and the requirements were made available in the study's information sheet (Appendix 3). The issues of anonymity and confidentiality were particularly highlighted for all selected participants. Their rights as participants were also elucidated. The participants were required to fill out the voluntary participation and informed consent form. Upon their agreement, the participants were informed that they had been recruited into the study.

A Physical Activity Readiness Questionnaire (PAR-Q) (Appendix 4) was sought from the participants in the ACT, as well as the structured exercise program group intervention (ACT-EX). Those who failed the PAR-Q were excluded from taking part in the study. PAR-Q is a screening questionnaire designed to obtain information regarding participants' health and

to ensure no injury or unwanted situation if they participate in the study. Once informed consent was provided, participants were directed to the first measurement point (baseline) comprised of the demographic's questionnaire, the AAQW-R18, the TFEQ-18 and DSQ-40. Participants were required to obtain anthropometry to collect body weight (in kilogram) and height (in centimeter) for BMI classification. The participants were expected to exhibit greater immature and neurotic defense styles than mature defense styles to be eligible to take part in the study. The participants were randomly assigned to one of the three groups; ACT (ACT) (n = 52), ACT and structured exercise (ACT-EX) (n = 50), or the control group (CG) (n = 50) by using the simple randomization protocol (Kim & Shin, 2014). Due to the totally virtual nature of the study and the large number of participants (over 100), this method is feasible.

Participants were randomly assigned to one of three groups. This was a single-blind study, where the participants did not know which group intervention they would receive; only the researchers were aware. One potential threat to validity is selection bias. Therefore, to minimize this, participants were informed that they would be assigned to one of three groups: ACT, ACT-EX, or CG. Group assignments were determined by the researcher, with participants unaware of their allocation until after assignments were made. Subsequently, participants underwent baseline assessments and were informed of session requirements.

The ACT and ACT-EX received intervention accordingly, while the CG received no intervention. On the final day of the interventions, post-intervention measurements were taken (week six). Participants were sent an online form link via their WhatsApp number and asked to complete the AAQW-R18, TFEQ-R18, DSQ-40 and provide their weight. Similarly, following the six weeks (week 12) post-intervention, the AAQW-R18, TFEQ-R18, DSQ-40, and weight were administered again, and the online form links were sent to participants' WhatsApp. All outcome measures were collected and compared to baseline data.

Figure 3.1 illustrates the items included in the study protocol. The RCT was conducted in accordance with the CONSORT guideline ("CONSORT 2010 Explanation and Elaboration: updated guidelines for reporting parallel group randomised trials," 2011) (Figure 3.2).

Timepoint	**STUDY PERIOD**					
	Recruiting participants	**Baseline measures**	**Assigning groups**	**Post allocation**		
				Baseline (week 0)	**Post intervention (week six)**	**Follow-up (week 12)**
Identification	x					
Eligibility screening - Immature & Neurotic defense style -OW/OB	x					
Informed consent		x				
Completion of baseline measures -BMI -AAQW-R18 -TFEQ-18 -DSQ-40		x		x		
Randomization			x			
INTERVENTIONS						
1. ACT (*n*=52)				←	→	
2. ACT-EX (*n*=50)				←	→	
Control group (*n* = 50)				←	→	
DATA COLLECTION Demographics		x				
Outcome measures: - BMI -AAQW-R18 -TFEQ-18 -DSQ-40					x	x

Figure 3.1: The study protocol items

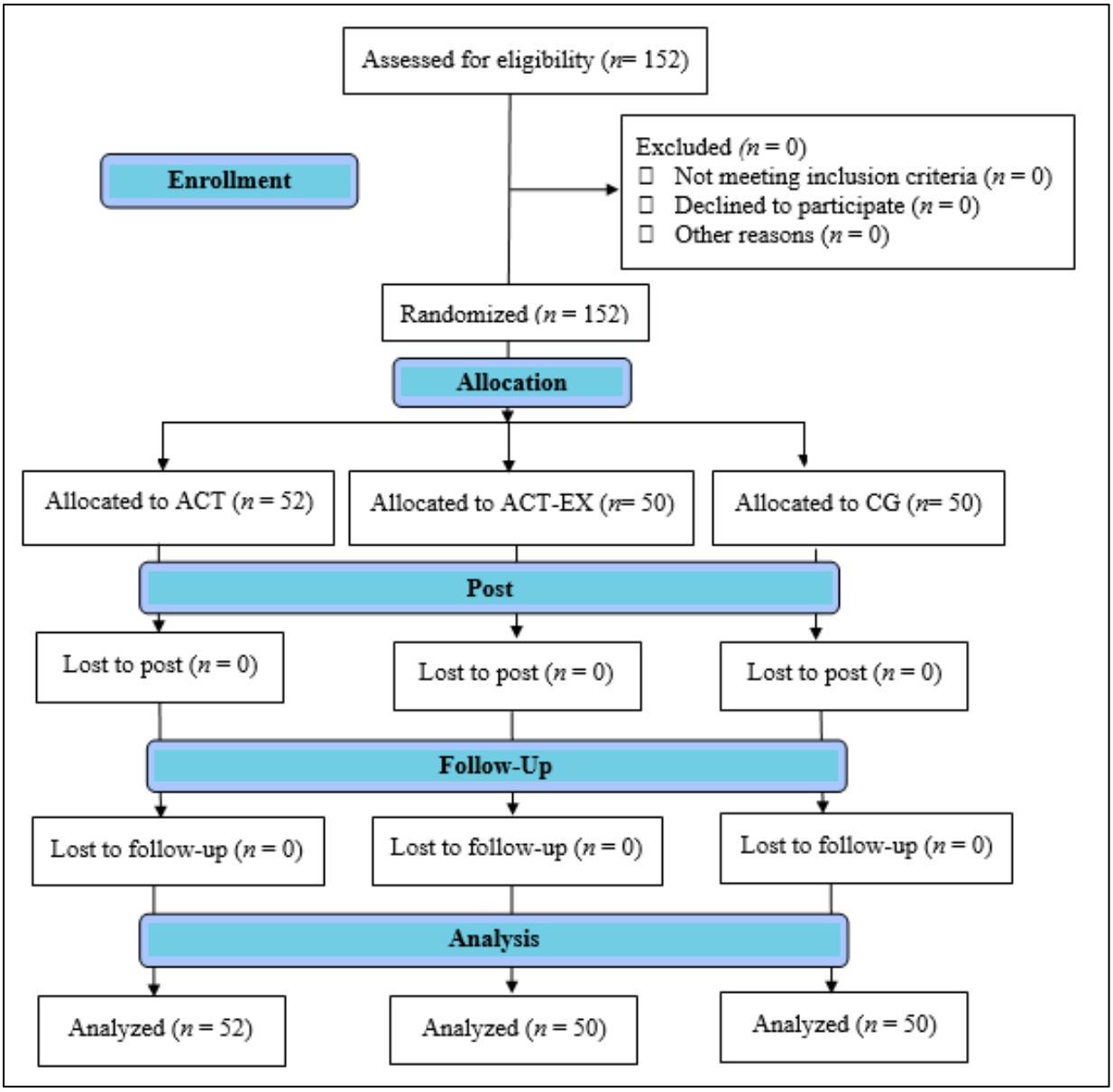


Figure 3.2: Participants flow diagram according to CONSORT guideline

3.4.1 Demographic Information

The demographic questionnaire describes the participants' demographic profiles, such as sex, age, race, study level, body weight, and height.

3.4.2 Weight-Related Psychological Flexibility

Acceptance and Action Questionnaire for Weight-Related Difficulties briefer version (AAQW-R18) was utilized to measure the weight-related psychological flexibility (WRF). The original version of this questionnaire is 22-item AAQW (AAQW-22) (Lillis & Hayes, 2008) which has shown a good internal consistency (α = 0.86). This test is designed to examine the acceptance of weight-related feelings, the disengagement from weight-related thoughts, and the extent to which thoughts and feelings interfere with valued behavior. It corresponds with a weight-related self-report, including obesity-related quality of life, bingeing, and exercise, as well as objectively measured body mass (Lillis & Hayes, 2008). The items are rated by using seven response options: 1 (never true), 2 (very seldom true), 3 (rarely true), 4 (sometimes true), 5 (frequently true), 6 (almost always true), and 7 (always true). The higher the score, the greater the psychological inflexibility.

A psychometric properties analysis has been conducted for convergent and criterion validity of this 22-item instrument among university students (Pitil & Ghazali, 2021b) (see Appendix 10). In the convergent validity analysis, the AAQW scores were correlated with the Three-Factor Eating Questionnaire-18 (TFEQ-18) (Karlsson et al., 2000), Uncontrolled Eating (UE) and Cognitive Restraint (CR) subscale scores. UE is the tendency to overeat due to a lack of control over food and a perceived sense of hunger, whereas CR is the desire to restrict food intake. CR is one of the dietary restrictions that comes in two styles: flexible control and rigid control (Westenhoefer et al., 1994). Moreover, acceptance-based therapy for weight management may be therapeutic for dietary habits (Järvelä-Reijonen et al., 2018; Juarascio et al., 2017). This supports the selection of these measures as exhibiting convergent validity. Positive and significant relationships were found between the AAQW score and the CR (r = 204) and UE (r = 0.386) subscales, but not with its criterion-related validity (BMI).

The 22-item characteristics are displayed in Table 3.7. Majority of the items are left-skewed (-0.808 to -0.031) and have modest kurtosis (-1.136 to -0.356). The corrected item-total correlation ranged from -.122 to .548. Respondents were instructed to rate "the truth of each statement as it applies to you" for the first 10 items, with responses ranging from "Never true" to "Always true." The responses range from "not at all" to "completely believable" for the following 12 items, which require respondents to rate the relevance or plausibility of each statement. Lower scores suggest less experiential avoidance and more psychological flexibility. Items 1, 6, 7, 14, and 18 are reverse-keyed. The scores that could be obtained ranged from 22 to 154.

Item 1 (*It's OK to feel fat*), Item 7 (*When I evaluate my weight or my appearance negatively, I am able to recognize that this is just a reaction, not an objective fact*), Item 14 (*I am in control of my eating behavior*), and Item 18 (*I am a stable person*) had low and negative correlations based on the range of the corrected item-total correlation. Consequently, they were exempted from further analyses. These items were stated positively; thus, they may be subjected to a degree of inconsistency when compared to other items, which may lead to more problematic eating behavior. As a result, these four items were excluded, revealing a stronger relationship with those measures (UE, r = 0.429; CR, r = 0.225) and BMI (r = 0.189) but in a low range (Table 3.1). This suggests that the new, revised AAQW has sufficient convergent and criterion validity for the population being studied. As there were only 18 items, the minimum and maximum total scores were set at 18 and 126, respectively.

The internal consistency was good for full-length 22-item, α = 0.694, however, it increased to α = 0.760 for the revised 18-item of AAQW. The results revealed that the elimination of four items would increase the internal consistency. Subsequently, an 18-item version of the AAWQ (AAQW-R18) was more precise and suitable for university students. In

addition, excellent internal consistency was found in the current sample (Phase 2 study sample) (baseline Cronbach's α = .68, post-intervention: Cronbach's α = .85, follow-up Cronbach's α = .88).

Additionally, the test-retest reliability assessed for the AAQW-R18 found a strong correlation, r = 0.978, suggesting a stable and reliable measurement (Table 3.2). The AAQW-R18 is reliable for use among university students from a functional standpoint. In this study, the AAQW-R18 was used because it is a solid predictor of psychological flexibility related to weight for university students.

Table 3.1: Item characteristics of the 22-item AAQW

Item	***M***	***SD***	**Skewness**	**Kurtosis**	$r_{ci\text{-}tc}$
Item 1	4.43	1.895	.247	-.927	-.046
Item 2	4.22	1.726	-.122	-.865	.207
Item 3	3.92	1.594	-.230	-.815	.168
Item 4	4.21	1.619	-.296	-.639	.172
Item 5	4.00	1.685	-.075	-.748	.242
Item 6	3.38	1.588	-.514	-.426	.132
Item 7	3.58	1.453	-.141	-.635	-.122
Item 8	4.95	1.466	-.808	.576	.022
Item 9	5.16	1.455	-.830	.539	.033
Item 10	4.09	1.852	-.104	-.995	.548
Item 11	3.94	1.898	.025	-1.136	.262

Table 3.1 continued

Item 12	4.11	1.389	-.101	-.398	.476
Item 13	3.50	1.715	.061	-.904	.423
Item 14	3.75	1.578	-.292	-.426	-.067
Item 15	3.72	1.588	-.113	-.798	.519
Item 16	3.78	1.486	-.120	-.356	.552
Item 17	4.14	1.457	-.350	-.142	.391
Item 18	3.25	1.361	-.795	.831	-.024
Item 19	3.73	1.674	.104	-.921	.374
Item 20	3.23	1.891	.461	-.953	.566
Item 21	3.82	1.659	-.031	-.504	.424
Item 22	2.56	1.669	.828	-.397	.427
OVERALL	85.475	13.25			
AAQW, α = .694; Average inter-item correlation = .091					
AAQW-R18, α = .760; Average inter-item correlation = .149					

Note. $r_{ci\text{-}tc}$: corrected item-total correlation, AAQW-R18: revised version of AAQW with omitted item 1, 7, 14, and 18

Table 3.2: Correlation Coefficients for AAQW, AAQW-R18 and Measures for Validation

	AAQW	**AAQW-R18**
$AAQW_2$	.917*	
UE	.386*	.429*
CR	.204*	.225*
BMI	.134	.189*

Note. CR and UE - the constructs in Three Factor Eating Questionnaire -18 (TFEQ-18)

AAQW-R18: revised version of AAQW with omitted item 1, 7, 14 and 18.

$AAQW_2$: the second measure for AAQW (retest).

BMI: Body mass index

*Correlation is significant at .05 ($p < .05$)

3.4.3 Eating Behavior

The eating behavior was assessed by using the Three-Factor Eating Questionnaire-Revised 18-item (TFEQ-18) (de Lauzon-Gullian et al., 2004). TFEQ-18 has three subscales measuring the following constructs:

1. Cognitive Restraint (CR) (6 items)

   This is the degree to which one restricts the amount and types of food consumed.

2. Uncontrol Eating (UE) (9 items)

   This is the extent to which one allows himself/herself to eat even if he/she is not hungry or is already full.

3. Emotional Eating (EE) (3 items)

   This indicates the frequent feeling of hunger or perceived hunger and the desire to eat at any time.

These three factors comprised statements that could be answered either as ‘definitely true’, ‘mostly true’, ‘mostly false’ or ‘definitely false’ (1 – 4). A high score indicates a high degree

of CR, UE, and EE, suggesting unhealthy eating behavior. The internal consistency was high and well established; CR (α = 0.84), UE (α = 0.83) and EE (α = 0.87) (de Lauzon et al., 2004). The EE and UE have been utilized in examining the convergent validity with AAQW instruments, which has been explained in the previous subchapter 3.5.2.

3.4.4 Defense Style (Defense Styles Questionnaire; DSQ-40)

The defense style was measured by using the Defense Styles Questionnaire (DSQ-40) (Andrews et al., 1993). It consists of 40 items measuring specifically 20 ego defenses (2 items for each defense) and scores for three factors; mature, neurotic, and immature. This instrument assesses 20 defense mechanisms at three different degrees of defense, spanning from the most adaptive to the least adaptive: mature, neurotic, and immature (Andrews et al., 1989; Bond et al., 1983). In order to generate an overall defense score, participants were asked to rate their level of agreement across different phrases that were designed to instinctively elicit appropriate defense styles.

The ratings for the pertinent items are aggregated to determine the scores for defense mechanisms and defense styles. On a Likert scale of 1 to 10, each item is rated, with a score of five or higher indicating stronger agreement with the defense style.

1. Mature (4 defense styles)

i. Sublimation

ii. Humor

iii. Anticipation

iv. Suppression

2. Neurotic (4 defense styles)

i. Undoing

ii. Pseudo-altruism

iii. Idealisation

iv. Reaction formation

3. Immature (12 defense styles)

i. Projection

ii. Passive-aggression

iii. Acting-out

iv. Isolation

v. Devaluation

vi. Autistic fantasy

vii. Denial

viii. Displacement

ix. Dissociation

x. Splitting

xi. Rationalization

xii. Somatization

By evaluating the criterion validity using BMI measurement, reliability analysis based on the Cronbach's alpha, α for internal consistency, and test-retest reliability, the psychometric features of the DSQ-40 had been investigated using a sample of university students (Pitil & Ghazali, 2021a) (see Appendix 11). A mature defense style and BMI demonstrated a significant relationship for criterion validity (r = 0.185, p < .05, small strength), but not immature or neurotic defense styles (p > .05). The correlations between the defense styles were moderate and significant (r = 0.259 to .586, p < .05), establishing the construct validity of the scale (Table 3.3).

Table 3.3: Correlations between Defense Styles

	BMI	**Mature**	**Neurotic**	**Immature**
Mature	.185*	1	.259*	.586*
Neurotic	.145		1	.312*
Immature	.142			1

*Correlation is significant at .05 ($p < .05$)

Internal consistency was high for the entire scale and subscale, $\alpha = 0.881$ and $\alpha = 0.875$ and for each of the defense styles; $mature_1 = .615$, $mature_2 = 0.605$, $neurotic_1 = 0.745$, $neurotic_2 = 0.721$ and $immature_1 = 0.834$, $immature_2 = 0.833$ in a test-retest analysis for two-week interval (Table 3.4). The test-retest reliability for the three defense styles ($r = 0.794 - 0.991$) and the overall DSQ-40 ($r = 0.926$) was high (Table 3.5). In addition, acceptable reliability was documented. The high correlation of test-retest scores and high internal consistency proved its stability and reliability. As a result, the DSQ-40 is valid and reliable for measuring defense styles among university students. Excellent internal consistency was found in the current sample (Phase 2 study's sample) (baseline Cronbach's $\alpha = .85$, post-intervention: Cronbach's $\alpha = .88$, follow-up Cronbach's $\alpha = .89$). Therefore, the DSQ-40 is an effective instrument for measuring the defense style of university students.

Table 3.4: Cronbach's α for DSQ-40

Defense style	α_1	α_2
Overall DSQ-40	.881	.875
Mature	.615	.605
Neurotic	.745	.721
Immature	.834	.833

α_1 : Cronbach's alpha time 1

α_2 : Cronbach's alpha time 2 (retest)

Table 3.5: Test-Retest Correlations of Defense Styles and Overall DSQ-40 in a Two-Week Interval

Defense style	***r***
Mature	.991*
Neurotic	.794*
Immature	.990*
Overall DSQ-40	.926*

*Correlation is significant at .05 ($p < .05$).

3.4.5 Intervention

3.4.5.1 ACT

This psychological therapy was a virtual by using the video conferencing, group-based treatment, with up to 52 participants per group. They attended the ACT sessions once a week for 1.5 hours per session for six weeks. The ACT was developed to foster psychological flexibility, which promotes openness, awareness, and commitment. The content of the sessions

was adapted from an Acceptance and Commitment Therapy (ACT) intervention designed for weight loss, as employed in previously published studies (Butryn et al., 2011; Tapper et al., 2009. To better align with the lifestyle of university students, the ACT components were tailored to address aspects of student life, including balancing study commitments with healthy lifestyle behaviors and addressing common challenges such as irregular schedules and limited access to healthy food options on campus. This discussion was integrated after obtaining input from the trial conducted before the actual intervention, as explained in subchapter 3.6.

The main elements of the intervention were (a) values, which increased motivation, (b) cognitive defusion, which helped break ties between thoughts and behavior linked to food and exercise, and (c) acceptance, which helped the participants accept uncomfortable emotions, (d) become more mindful, and (e) committed to weight loss-related values (Table 3.6). The sessions were led by the researcher, who had been trained in an ACT workshop. The researcher received two days of training on ACT, which involved clarification of its principles and role-playing to help the researcher practice using the ACT manual. Furthermore, the researcher also received online training conducted by Professor Steven Hayes, the founder of ACT (refer to Appendix 5 and 6).

Participants were allowed to take notes during the sessions and were given the theoretical component of the ACT model. At the end of the sessions, homework tasks were also included. In order to increase participation, the program's content addressed the participants' personally identified values. The intervention was well-attended, with 100% attendance (refer Appendix 17). The feasibility of the virtual video conference and group-based treatment contributed to this success.

Table 3.6: Content of ACT sessions

Session/component	Aims	Key metaphors and exercises	Application to weight loss
1 Values	-To identify personal values. -To determine whether weight loss would support such values	The choice point. Values assessment rating.	Enhance motivation to lose weight
2 Cognitive defusion	-To learn to distance from distressing thoughts about bodyweight and strengthen their commitment to health-related values.	Push papers	To become aware of when thoughts may sabotage diet and exercise plans. To help break link between diet/food-related thoughts and behavior
3 Acceptance/willingness	-To increase willingness to experience aversive internal states, the distress that associated with physical activity (e.g.; fatigue, physical discomfort, urges to stop) and diet-related feelings (e.g.; cravings)	Breathing exercise	To help the participants tolerate negative emotions (physical exercise and diet-related feelings) rather than rely solely on control or avoidance strategies.

Table 3.6 continued

4 Mindfulness	To develop a sense of self that can enable thoughts and feelings to flow without attachment. To enable the participant to stay in non-judgmental contact with psychological and environmental events as they occur.	Observational self-exercise. Be where you are exercise	To aid defusion and acceptance strategies.
5 Committed action	To become aware of the importance of committing to values. To identify goals consistent with the participant's values	Goals, barriers and action exercise. Living in accordance with values exercise.	To help the participant set and achieve weight loss goals. To encourage adherence to weight loss/maintenance strategies over the long term.
6 Review	To review participants' experience over the intervening weeks and help clarify any difficulties they may have had. To remind participants of key concept	Question and answer session. Selection of exercises and metaphors from previous sessions.	Same as before.

3.4.5.2 Structured Exercise Program

The structured exercise program was conducted by the researcher, encompassing three virtual sessions per week over a duration of six weeks. The researcher possesses expertise and certifies in leading exercise programs tailored for overweight and obese population (see Appendix 18). With a background in sports and exercise science, the researcher adeptly administered the exercise program. A minimum of 24 hours between sessions was allocated to allow for recovery and to avoid injury. Each session consisted of 60 minutes of moderate-intensity exercise. The exercise guideline follows the guideline based on the American College of Sports Medicine (Jakicic et al., 2019). A minimum of 150 minutes of moderate intensity per week was suggested for an overweight or obese population for weight loss (WHO, 2017). A total body workout was implemented for all sessions. The intensity of exercise was between 65% to 85% of maximum heart rate (HRmax) or Rate of Perceived Exertion (RPE) of 12 – fairly light to 15 – hard (Borg, 1982) (Table 3.7).

The percentage of HRmax was utilized to calculate the target HR. Specifically, HRmax is equal to 220 minus age. The study participants' age ranged from 18 to 25 years old, thus their HRmax was between 195 bpm and 20 bpm. The target HR was determined by the percentage of exercise intensity multiplied by 220 minus age. Table 3.8 shows the target HR by age and the percentage of the exercise intensity.

In each exercise session, the participants were instructed to monitor their HR with a smartwatch or their RPE using the Borg scale. The exercises were bodyweight moves like push-ups, squats, lunges, and crunches that worked the large muscle groups. A warm-up and cool-down were executed at the beginning and end of each session.

Table. 3.7: Rating of perceived exertion (RPE) category scale

Point	Effort	Description	% of HRmax
6	Very, very light	Little to no movement, very relaxed	20
7		Able to maintain pace	30
8	Very light	Comfortable and breathing harder	40
9			50
10	Fairly light		55
11		Minimal sweating, can talk easily	60
12	Somewhat hard	Slight breathlessness, can talk	65
13			70
14	Hard	Increased sweating, still able hold conversation but with difficulty	75
15		Sweating, able to push and still maintain proper form	80
16	Very hard	Can keep a fast pace for a short period	85
17			90
18	Extremely hard	Difficulty breathing, near muscle exhaustion	95
19			100
20	Maximally hard	Total exhaustion	

Table 3.8: Target HR based on age and exercise intensity

Age	HRmax (220 – age)	65% of HRmax	85% of HRmax
		Target HR (bpm) [% x (220 – age)]	
18	202	131	172
19	201	131	172
20	200	130	170
21	199	129	169
22	198	129	168
23	197	128	167
24	196	127	167
25	195	127	166

Note. HRmax: Heart rate maximum, Bpm: Beat per minute

3.4.5.3 ACT-EX

The ACT sessions were held once a week for 1.5 hours, as explained in the previous subchapter 3.4.5.1. Additionally, the exercise program was scheduled for three sessions per week, each lasting for 1 hour, with a 24-hour gap between sessions. Fifty participants (n = 50) were allocated to this group. Consequently, for the six weeks, participants in the combined ACT with a structured exercise program (ACT-EX) group received four sessions per week of an intervention program (Table 3.9). The sessions were conducted live, in a group setting, in a virtual environment, utilizing video conferencing.

Table 3.9 ACT-EX sessions

Session	Component
1	ACT session 1– Values (1.5 hour)
2	Exercise (1 hour) • Warm-up (5 minutes) -Jumping jacks -High knees • Major muscle groups exercises: -Squats -Lunges -Push up -Crunches -Plank 3 Sets (20 seconds per exercise) * 3 - 5 minutes rest between sets • Cooling down (5 minutes)
3	
4	
5	ACT session 2 – Cognitive Defusion (1.5 hour)
6	Exercise (1 hour) • Warm-up (5 minutes) -Jumping jacks -High knees • Major muscle groups exercises: -Squats - Lateral Lunges -Push up -Leg raises -Side Plank (Left – Right) 3 Sets (20 seconds per exercise) * 3 - 5 minutes rest between sets Cooling down (5 minutes)
7	
8	
9	ACT session 3 – Acceptance/Willingness (1.5 hour)

Table 3.9 continued

10 11 12	Exercise (1 hour) • Warm-up (5 minutes) -Jumping jacks -High knees • Major muscle groups exercises: -Squats - Lateral Lunges -Push up -Alternate hand-feet touches - Side Plank (Left – Right) Cooling down (5 minutes) 3 Sets (30 seconds per exercise) * 3 - 5 minutes rest
13	ACT session 4 – Mindfulness (1.5 hour)
14	Exercise (1 hour) • Warm-up (5 minutes)
15 16	Jumping jacks -High knees • Major muscle groups exercises: -Squats - Lateral Lunges -Push up twist - Leg raises -Plank Cooling down (5 minutes) 3 Sets (30 seconds per exercise) * 3 - 5 minutes rest between sets
17	ACT session 5 – Committed Action (1.5 hours)
18 19 20	Exercise (1 hour) • Warm-up (5 minutes) -Jumping jacks -High knees • Major muscle groups exercises: -Squats - Lateral Lunges -Push up twist - Leg raises -Plank Cooling down (5 minutes) 3 Sets (12-15 repetitions per exercise) * 3 - 5 minutes rest between sets

Table 3.9 continued

21	ACT session 6 – Review (1.5 hours)
22	Exercise (1 hour) • Warm-up (5 minutes) -Jumping jacks -High knees • Major muscle groups exercises: -Squats - Single-leg lunges (left/right) -Push up twist - Leg raises -Plank 3 Sets (12 – 15 repetitions per exercise) * 3 - 5 minutes rest between sets Cooling down (5 minutes)
23	
24	

3.4.5.4 Control group

This group received no intervention for the whole 12 weeks. They were required to participate in the baseline, week six, and week 12 follow-up.

3.5 Pilot Study

Prior to the actual data collection, a pilot study was carried out to assess the reliability, validity, and internal consistency of both the DSQ-40 and the AAQW. One hundred and twenty university students were recruited for this purpose. They were recruited from the Faculty of Sports Science and Recreation using a convenience sample and were chosen based on their volunteer engagement. Due to the participants' accessibility and representation of university students, this sample technique was used (Gravetter & Forzano, 2012). The pilot study was conducted before the pandemic, thus reducing the limitations of this study by using a physical approach. Each participant provided informed consent in order to take part in this study. Face-

to-face meetings were held to complete the questionnaire, and a token of appreciation was given.

A standard protocol of body weight and height measurement was performed for BMI evaluation. The BMI was obtained in order to assess criterion validity using the DSQ-40 and AAQW. It was expected that there would be significant relationships between defense styles and BMI. AAQW's convergent validity and correlation with TFEQ subdomains UE and CR were evaluated. A test-retest protocol was employed to determine reliability. Following this technique, the same questionnaire was needed twice from the same individuals. These were done over a period of time. A measurement's reliability is determined by its repeatability or consistency (Hopkins, 2000). It is a measure of the robustness of the scale, that is, the ability to generate consistent scores over time in a stable population (Aaronson et al., 2002). Participants completed the questionnaire twice, separated by two weeks. A small interval would anticipate some correlation (Brinkman, 2009). Therefore, in this study, a two-week interval was chosen to be given between the two administrations of the questionnaire to the participants.

The questionnaires were gathered instantly after completion to prevent participants from double-checking their answers. During the administration of the questionnaire, indirect construct validity was assessed. The input of the participants was acquired regarding the words or terms they did not comprehend. A brief explanation of the terms was provided so that the participants would understand how they were used in the phrases. This type of feedback is crucial to ensuring that participants respond to the intended construct. Based on this information, the words or terms were then modified to accommodate the participants' comprehension. For instance, the word "*inhibited*" was changed to "*self-consciousness*" in DSQ-40, Item 13: "*I'm a highly inhibited person*" This alters the meaning of Item 13 to: "*I am*

a very self-conscious individual". Changing the statement would provide a clearer understanding of the construct's meaning and hence more precisely measure the construct.

The results of this pilot study were reported in subchapter 3.5.2 for AAQW and 3.5.4 for DSQ-40. The two subdomains of TFEQ-18; UE and CR have been used in examining the convergent validity of AAQW instruments, which has been explained in the previous subchapter, 3.5.2. The newly revised version of AAQW, the AAQW-R18 was employed in this study.

The ACT module was adapted from published studies (Butryn et al., 2011; Tapper et al., 2009). Two participants were included as part of the trial for each of the six ACT sessions that were held once a week with the researcher for an hour. Through the use of in-session exercises and questions presented to the participants about the discussed themes, active participation in the session was demanded of each participant. In order to reinforce the themes covered each week, each participant also received session tasks. The description for each session is shown in Table 3.13. All feedback were noted, and the ACT content was adjusted to prepare for the actual intervention without changing the aim of the session. This trial was really helpful in easing the researcher to conduct the actual ACT sessions with a larger number of participants. Even though the actual ACT intervention was conducted in video conference, the aim of each session was met and the same goes for the trials.

3.6 Data Analysis

All statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS) Version 26 software. Assumptions of all statistical analyses were assessed. Normality assumption was checked by using skewness, kurtosis and Kolmogorov-Smirnov ($p > .05$). The descriptive statistics were presented in mean and standard deviation (M ± SD). Repeated measure analysis of variance (ANOVA) (3 x 5) was conducted to measure the

effectiveness of the interventions (ACT or ACT-EX) on the outcome measures; BMI, WRF (AAQW-R18 score), eating behavior (CR, UE and EE) and defense style over three time points (baseline, post-intervention (week 6), and follow-up (week 12). Partial eta squared (η_p^2) effect sizes were presented for the ANOVA results with small, moderate, and large effect sizes corresponding to 0.01, 0.06, and 0.14, respectively. Cohen's *d* was calculated from baseline to post-intervention (week six), from post-intervention to follow-up (week 12) within and between groups to compute effect sizes using the estimated values. A within-group effect size of 0.5, 0.8, and 1.1 was considered small, moderate, and large respectively, whereas a between-group effect size of 0.2 was considered small, 0.5 medium, and 0.8 large (Cohen, 2013). All analyses were conducted with a significance level of .05 ($p < .05$).

The summary of all data analysis by research objectives is outlined in Table 3.10.

Table 3.10 Summary of data analysis by research objectives

No	Research objective	Data analysis
1	To explore the prevalence of OW/OB among university students during COVID-19 pandemic.	Descriptive statistics • To present mean and SD, frequencies and percentages for all variables • Independent sample t-tests and ANOVA for comparing by demographic variables.
2	To examine the effectiveness of ACT on weight-related psychological flexibility (WRF), BMI, eating behavior (CR, UE and EE) and defense styles (mature, immature and neurotic) of the university students.	Repeated-measure ANOVA (3 x 5)

Table 3.10 continued

3	To examine the effectiveness of ACT and structured exercise program (ACT-EX) on WRF, BMI, eating behavior (CR, UE and EE) and defense styles (mature, immature and neurotic) of the university students.	
4	To compare the effectiveness of ACT and ACT-EX on WRF, BMI, eating behavior (CR, UE and EE) and defense styles (mature, immature and neurotic) of the university students.	

CHAPTER 4

RESULTS AND DISCUSSION

This section analyses the results of the research objectives related to the prevalence of overweight and obesity for the Phase 1 study, the effectiveness of ACT or ACT-EX on BMI, AAQW score, eating behavior, and defense style of the participants for Phase 2 study.

4.1 Phase 1 Study

4.1.1 A Descriptive Analysis of the Participants' Characteristics

Data analysis was performed for a total of 622 participating university students. This study achieved a 100% response rate by analyzing the data from all 622 participants. Table 4.1 presents the participants' demographic details. A higher proportion of the participants were female students (72.9%) compared to male students (28.1%). Most of the participants (56.9%) were 18-20 years old, followed by those between 21-23 years old (39.5%), and those 24 years old and above (3.5%).

4.1.2 Prevalence of Overweight and Obesity

In accordance with the WHO classification, the prevalence of normal, overweight, and obesity was 57.1%, 14.3%, and 10.1%, while the comparable prevalence according to the Asian classification was 42.1%, 22.2%, and 16.9%. Meanwhile, the prevalence of underweight was 18.5% for the WHO classification and 18.8% for the Asian classification.

Male students had a significantly higher BMI (24.25 ± 5.88 kg/m^2) than female students (22.50 ± 4.93 kg/m^2) ($p < .05$), with a very large effect size, Cohen's $d = 0.32$. One-way ANOVA results indicated that, in comparison to younger participants, older participants had significantly higher body weight and BMI (Table 4.1). There were also significant differences

in weight and BMI among males across age groups ($p < .05$, small effect size, $\eta_p^2 = 0.04 – 0.09$). Participants aged 24 years and above (Weight, 81.79 ± 26.66 kg; BMI, 28.6 ± 7.12 kg/m^2) recorded the highest mean score in comparison to the other age groups (Weight, 18–20 years old = 69.04 ± 18.94 kg, 21–23 years old = 70.89 ± 17.32 kg; BMI, 18–20 years old = 23.31 ± 5.85 kg/m^2, 21–23 years old = 24.77 ± 5.65 kg/m^2). For females, no variable demonstrated a significant difference ($p > .05$). However, a significant difference in the mean BMI between the associate's and bachelor's degree levels of study was identified (associates = 22.43 ± 5.23 kg/m^2, bachelor's degree = 23.64 ± 5.24 kg/m^2 ($p < .05$)) with a very weak effect size, $\eta_P^2 = 0.013$ (Table 4.2).

Based on WHO and Asian classifications, differences in BMI categories between age groups by gender were also analyzed (see Table 4.3). The BMI for age groups varied significantly among males ($p < .05$) with a large effect size (Cramer's V = 0.20), but not among females ($p > .05$). When the Asian cut-offs were used, the proportions of overweight and obese were slightly higher for both males and females. The percentage of normal weight was, however, a little lower than the WHO classification. Likewise, there was no apparent difference in the proportion of underweight individuals between the two classifications. In both classifications, the BMI groups differed significantly ($p < .05$) with a large effect size (Cramer's V = 0.20).

Figure 4.1 illustrates the proportion of each BMI group. The proportions of BMI groups according to WHO and Asian cut-offs are shown in Figures 4.1a and 4.1b, respectively.

Table 4.1: Demographic Characteristics of the Participants

Variables	**Frequency (*N* = 622)**		**Percentage (%)**	
Gender				
Male	175		28.1	
Female	447		72.9	
Age (years)				
18 – 20	354		56.9	
21 – 23	246		39.5	
≥ 24	22		3.5	
BMI	WHO	Asian	WHO	Asian
Underweight	116	116	18.6	18.6
Normal weight	354	263	56.9	42.3
Overweight	89	138	14.3	22.2
Obese	63	105	10.1	16.9
Level of study				
Associates	330		53.1	
Bachelor's degree	292		46.9	

Table 4.2: Mean and Standard Deviation ($M \pm SD$) Of Height, Weight, and BMI of University Students by Age Group

Gender	**Variable**			**18 – 20 years old** 354 (56.9)	**21 – 23 years old** 246 (39.5)	**≥ 24 years old** 22 (3.5)	***p*-value**	η_p^2
Male								
n = 175 (28.1%)	*n*			80	87	8		
	Height (m)	1.68 ± .07		1.67 ± .07	1.69 ± .06	1.70 ± .08	.274	
	Weight (kg)	69.04 ± 18.94		65.75 ± 19.21	70.89 ± 17.32	81.79 ± 26.66	.031*	0.04
	BMI (kg/m^2)	24.25 ± 5.88ø	Cohen's *d* = 0.32	23.31 ± 5.85	24.77 ± 5.65	28.6 ± 7.12	.046*	0.23
Female								
n = 447 (71.9%)	*n*			274	159	14		
	Height (m)	1.56 ± .06		1.56 ± .06	1.57 ± .064	1.55 ± .05	.515	
	Weight (kg)	55.16 ± 13.57		54.21 ± 13.44	56.87 ± 13.87	54.36 ± 11.67	.140	0.09
	BMI (kg/m^2)	22.50 ± 4.93ø		22.16 ± 4.85	23.08 ± 5.06	22.54 ± 4.49	.169	0.08

Table 4.2 continued

Study level				
Associates *n* = 330 (53.1%)	BMI (kg/m^2)	22.43 ± 5.23	*p*-value = .004*	η^2 = 0.01
Bachelor's degree *n* = 292 (46.9%)		23.64 ± 5.24		

Note. BMI: body mass index, η_p^2: partial eta squared

*$p < .05$, $^{ø}p < .05$ for BMI between gender.

Equal variance assumption was satisfied in all compared variables ($p > .05$).

Table 4.3: Prevalence of BMI among University Students by Age Groups and Study Levels

Variables		**International classification (WHO)**						**Asian classification**					
		UW (<18.5kg /m^2) *n* = 116 (18.6%)	**NW (18.5 – 24.9 kg/m^2) *n* = 354 (56.9%)**	**OW (25.0 – 29.9 kg/m^2) *n* = 89 (14.3%)**	**OB (≥ 30 kg/m^2) *n* = 63 (10.1%)**	***p-value***	**CV**	**UW (<18.5kg /m^2) *n* = 116 (18.6%)**	**NW (18.5 – 22.9 kg/m^2) *n* = 263 (42.3%)**	**OW (23.0 – 27.4 kg/m^2) *n* = 138 (22.2)**	**OB (≥ 27.5 kg/m^2) *n* = 105 (16.9%)**	***p***	**CV**
Gender	Male	25 (14.3)	92 (52.6)	28 (16.0)	30 (17.1)	.001*	.16	25 (14.3)	65 (37.1)	40 (22.9)	45 (25.7)	.002*	.16
	Female	91 (20.4)	262 (58.6)	61 (13.6)	33 (7.4)			91 (20.4)	198 (44.3)	98 (21.9)	60 (13.4)		
	Age group												
Male(*n*= 175)	18 – 20	15 (18.8)	42 (52.5)	17 (21.3)	6 (7.5)	.027*	.20	15 (18.8)	29 (36.3)	24 (30.0)	12 (15.0)	.029*	.20

Table 4.3 continued

	21 – 23	10 (11.5)	46 (52.9)	9 (10.3)	22 (25.3)			10 (11.5)	34 (39.1)	14 (16.1)	29 (33.3)		
	≥24	0 (0)	4 (50.0)	2 (25.0)	2 (25.3)			0 (0)	2 (25.0)	2 (25.0)	4 (50.0)		
Female (*n*=447)	18 – 20	61 (22.6)	162 (59.1)	30 (10.9)	20 (7.3)	.416	.08	62 (22.6)	125 (45.6)	55 (20.1)	32 (11.7)	.419	.08
	21 – 23	26 (16.4)	93 (58.5)	28 (17.6)	12 (7.5)			26 (16.4)	67 (42.1)	41 (25.8)	25 (15.7)		
	≥24	3 (21.4)	7 (50.0)	3 (21.4)	1 (7.1)			3 (21.4)	6 (42.9)	2 (14.3)	3 (21.4)		

Table 4.3 continued

Study level	Associates	76 (23.0)	184 (55.8)	44 (13.3)	26 (7.9)	.010*	.14	76 (23.0)	142 (43.0)	66 (20.0)	46 (13.9)	.006*	.14
	Bachelor's degree	40 (13.7)	170 (58.2)	45 (15.4)	37 (12.7)			40 (13.7)	121 (41.4)	72 (24.7)	59 (20.2)		
Male (*n*=175)	Associates	15 (17.6)	45 (52.9)	17 (20.0)	8 (9.4)	.033*	.22	15 (17.6)	34 (40.0)	21 (24.7)	15 (17.6)	.107	.19
	Bachelor's degree	10 (11.1)	47 (52.2)	11 (12.2)	22 (24.4)			10 (11.1)	31 (34.4)	19 (21.1)	30 (33.3)		
Female (*n*=447)	Associates	61 (24.9)	139 (56.7)	27 (11.0)	18 (7.3)	.036*	.14	61 (24.9)	108 (44.1)	45 (18.4)	31 (12.7)	.031*	.14
	Bachelor's degree	30 (14.9)	123 (60.9)	34 (16.8)	15 (7.4)			30 (14.9)	90 (44.6)	53 (26.2)	29 (14.4)		

Note. UW: Underweight, NW: Normal weight, OW: Overweight, OB: Obese, CV: Cramer's V *$p < .05$ for Pearson chi-square test

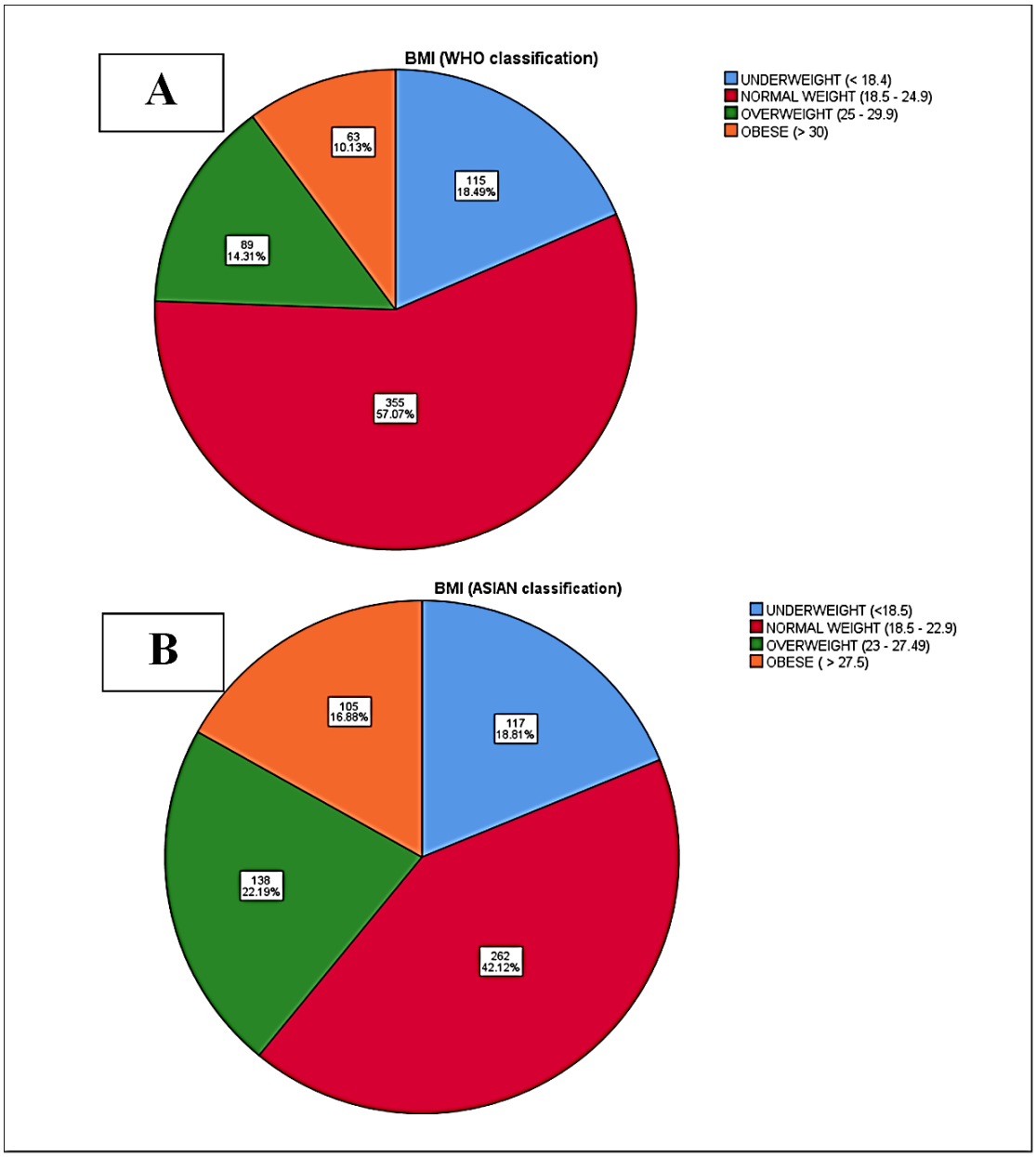


Figure 4.1: The proportion of BMI based on WHO (4.1a) and ASIAN cut-off point (4.1b)

4.2 Phase 2 Study

4.2.1 Statistical Assumption

Before further analysis was done, the normality of the data was tested using skewness and kurtosis. For all variables, skewness and kurtosis values were within the acceptable range of ± 2 and ± 3, except for AAQW R-18 score (Kurtosis = 3.79). Kolmogorov-Smirnov test analysis was also performed to further test the normality of all variables. All variables conformed to assumptions of normal distribution, except for BMI and all TFEQ-18 subscales. As the BMI and the subscales were within the acceptable range in terms of skewness and kurtosis, all the studied variables were considered normally distributed (see Table 4.4).

Table 4.4: Normality analysis for all variables measured

Variables	**Skewness**	**Kurtosis**	**Kolmogorov-Smirnov statistics**	***p*-value**
Defense style				
Mature	.229	-.076	.071	.060
Immature	.638	.465	.071	.060
Neurotic	.275	-.162	.058	.200
AAQW R-18 score	.784	3.791	.063	.200
BMI	.795	.703	.108	.001*
Eating behavior				
CR	.145	.619	.093	.003*
UE	-.341	.373	.088	.006*
EE	-.110	-.529	.104	.001*

Note. AAQW R-18: Weight-related psychological flexibility, BMI: Body mass index, CR: Cognitive Restraint, UE: Uncontrolled eating, EE: Emotional eating

*Significant level is at .05 ($p < .05$)

4.2.2 A Descriptive Analysis of Participants' Characteristics

At initial screening, all participants ($N = 152$) reported a moderate mean score for mature defense styles and moderate to high mean scores for immature and neurotic defense styles. The BMI mean score was in the obese category in all the assigned groups.

One-way ANOVA was conducted to compare the three groups (ACT, ACT-EX, and CG) at baseline across all variables, except for gender, which was analyzed using Chi-square analysis. BMI, immature defense style, and EE were significantly higher in the CG than in the two groups ($p < .05$), but no significant differences were identified for other variables. Additionally, the Chi-square analysis revealed no significant difference in gender distribution among the groups. Furthermore, the post-hoc analysis indicated that BMI, immature defense style, and EE showed no significant differences between the ACT and ACT-EX groups. Therefore, these results demonstrate the equivalence of all outcome measures at baseline ($p > 0.05$) (see Table 4.5). All participants had a BMI of the overweight and obese category (minimum: 23.05kg/m^2, maximum: 48.87kg/m^2). Parametric tests were applied to analyze all the outcome measures.

Table 4.5: Participants' baseline demographic and characteristics by group assignment (N = 152)

Variables	ACT (n = 52)	ACT-EX (n = 50)	CG (n = 50)	p
Age (years)	20.69 ± 1.65	21.32 ± 1.20	21. 68 ± 1.60	> .05
Sex (M:F), *n*	19 : 33	11 : 39	24 : 26	> .05[a]
Weight (kg)	78.57 ± 15.16	79.38 ± 17.41	86.24 ± 18.35	≥.05
BMI (kg/m^2)	30.13 ± 4.83[b]	30.01 ± 4.63[b]	32.60 ± 4.84	< .05, > .05[b]
Mature	6.87 ± 1.13	6.71 ± 1.14	6.53 ± 1.27	> .05
Immature	7.32 ± 0.59[b]	7.11 ± 0.75[b]	7.65 ± 0.74	< .05, > .05[b]
Neurotic	8.08 ± 0.59	7.85 ± 0.72	7.96 ± 0.88	> .05
AAQW-R18 score [c]	81.60 ± 15.99	80.86 ± 10.69	82.28 ± 15.46	> .05
Eating behavior (TFEQ-18 score) [d]				
CR	2.68 ± 0.41	2.66 ± 0.38	2.72 ± 0.49	> .05
UE	2.82 ± 0.30	2.71 ± 0.53	2.64 ± 0.40	> .05
EE	2.80 ± 0.50[b]	2.93 ± 0.75[b]	3.11 ± 0.55	< .05, > .05[b]

Note. Values are $n/M \pm SD$, ACT: ACT group, ACT-EX: ACT and structured exercise group, CG: control group, M: Male, F: Female, BMI: Body Mass Index, CR: Cognitive Restraint, UE: Uncontrolled Eating, EE: Emotional Eating, AAQW-R18 score: weight-related psychological flexibility score

[a] p-value for differences between ACT, ACT-EX, and CG in gender (Chi-square analysis revealed >.05)

[b] Post-hoc analysis revealed differences between ACT and ACT-EX (p > .05)

[c] Range is 18 to 126. Higher scores indicate greater weight-related psychological inflexibility.

[d] Range is 1 to 4. Higher scores indicate a greater degree of CR, UE, or EE.

4.3 Hypothesis Testing

4.3.1 Hypothesis 1

Hypothesis 1: There is a significant difference in WRF between ACT, ACT-EX, and CG across the three time points (baseline, post-intervention (week 6) and follow-up (week 12))

Hypothesis 1 examined the WRF (AAQW R-18 score) changes at three time points (baseline, post-intervention (week 6) and follow-up (week 12)) between the three groups. The interaction between time and groups on AAQW R-18 score was significant [F (4, 296) = 16.33, p = .001, η_p^2 = 0.18]. In the two groups: ACT and ACT-EX, the main effect of three conditions on the AAQW R-18 score was statistically significant *[*F (2, 148) = 50.09, p = .001 (p < .05), η_p^2 = 0.40]: ACT and ACT-EX. Both groups demonstrated a significant improvement in AAQW-R18 score across the three time points (low scores indicate greater psychological flexibility) with a large effect size (Table 4.6).

The main effect was significant with a large effect size when comparing the two types of interventions [F (2, 148) = 46.47, p = .001 (p < .05), η_p^2 = 0.38] (Table 4.7). The pairwise comparisons (with Bonferroni adjustment) indicated that AAQW-R18 score was significantly greater in the CG compared to the ACT and ACT-EX based on the mean difference (Table 4.8). Thus, hypothesis 1 was accepted given that there is a significant difference in AAQW-R18 score between ACT, ACT-EX, and CG across the three time points (baseline, post-intervention (week 6) and follow-up (week 12)).

The ACT and ACT with structured exercise interventions were effective in improving AAQW score in ACT as evident in Figure 4.2. The AAQW-R18 score increased over time in both conditions (ACT and ACT-EX) at week six, and the increment was greater in the ACT-EX condition than in the ACT condition at all time points. In ACT-EX, the AAQW-R18 score was almost stagnant from week six to week 12 but improved steadily in the ACT. The CG did

not demonstrate any improvement in the AAQW-R18 score over the three periods. Tables 4.9 and 4.10 present the descriptive statistics, as well as within-group and between-group effect sizes for the AAQW-R18 score in all the groups across the three-time points. The within-group effect sizes for ACT were small from baseline to post-intervention (*ds* = -0.74) and from post-intervention to follow-up (*ds* = -0.05). Meanwhile, the effect sizes for ACT-EX were large from baseline to post-intervention (*d*s = -2.17) and reduced to small from post-intervention to follow-up (*d*s = -0.6). The CG recorded a small effect size from baseline to post-intervention and follow-up (*d*s = 0.05 and 0.09). The between-group effect sizes for ACT and ACT-EX were large at post-intervention (*d* = 1.40) and follow-up (*d* = 1.42). Comparisons between the CG and both intervention groups have large to medium effect sizes in post-intervention and follow-up (ACT, d = 0.93 and 1.5; ACT-EX, d = 3.5 and 3.06)

Table 4.6: Multivariate tests for main effect and interaction effect over time for AAQW-R18 score

Effect	**Wilks' Lambda**	***F***	**Hypothesis df**	**Error df**	***p*-value**	η_p^2
AAQW-R18 score (main)	.596	50.09	2	148	.001*	.40
AAQW-R18 score*group (interaction over time)	.671	16.33	4	296	.001*	.18

Note. AAQW-R18 score: Weight-related psychological flexibility

*Significant level at .05 ($p < .05$)

Table 4.7: Between-subjects effects (ACT, ACT-EX and CG) on AAQW-R18 score

Type III Sum of Squares	**df**	**Mean²**	**F**	**p-value**	η_p^2
24856.24	2	12428.12	46.47	.001*	.38

*Significant level at .05 ($p < .05$).

Table 4.8: Pairwise Comparisons between ACT, ACT-EX and CG in AAQW-R18 score

(I) Group	**(J) Group**	**Mean Difference (I-J)**	***p*-value**
ACT	ACT-EX	9.90	.001*
	CG	-8.28	.001*
ACT-EX	ACT	-9.90	.001*
	CG	-18.18	.001*
CG	ACT	8.28	.001*
	ACT-EX	18.18	.001*

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise group, CG: Control group

*Significant level at .05 ($p < .05$).

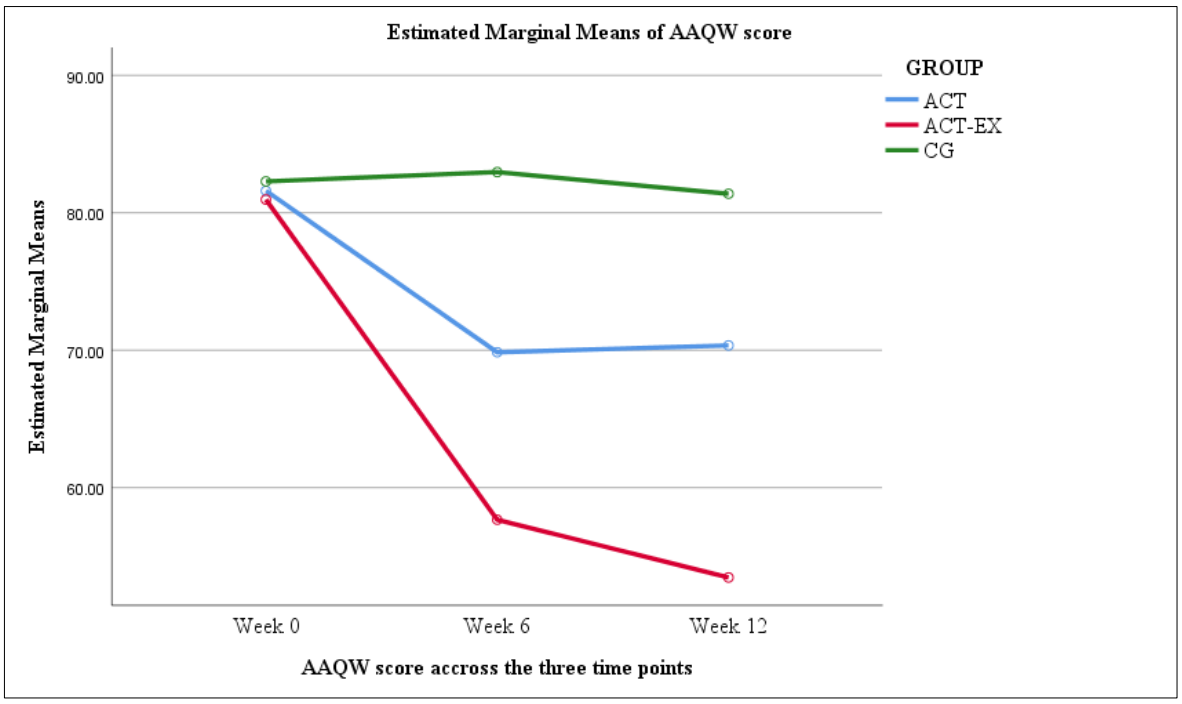


Figure 4.4: Means Plot For AAQW-R18 Score Across the Three Time Points by Groups

Table 4.9: Descriptive Statistics for AAQW-R18 Score Across the Three Time Points

Measure	Baseline			Post-intervention			Follow-up		
	ACT	ACT-EX	CG	ACT	ACT-EX	CG	ACT	ACT-EX	CG
	Mean ± SD								
AAQW-R18 score	81.60 ± 15.99[a]	80.86 ± 10.69[a]	82.28 ± 15.46	69.85 ± 8.68	57.66 ± 7.25	82.86 ± 16.06	70.34 ± 11.82	53.46 ± 9.11	81.38 ± 17.09

Note. AAQW-R18 score: Weight-related psychological flexibility, ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise group, CG: Control group

[a]*p*-value difference between ACT and ACT-EX group (One-way ANOVA's post-hoc test revealed > .05).

Table 4.10: Within-Group and Between Group Effect Size for AAQW Score (Cohen's *d*)

Variable	**Group**	**Within-group *d*s**		**Between-group *d***		
		Baseline to post-intervention	**Post-intervention to follow-up**		**Post-intervention**	**Follow-up**
AAQW-R18 score	ACT	-0.74	-0.05	ACT – ACT-EX	1.40	1.42
	ACT-EX	-2.17	-0.6	ACT-EX – CG	3.5	3.1
	CG	0.05	-0.09	ACT - CG	1.5	0.9

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise group, CG: Control group, AAQW-R18 score: Weight-related psychological flexibility

Positive *d's* indicate increases in score over time and negative *d's* indicate decreases.

4.3.2 Hypothesis 2

Hypothesis 2: There is a significant difference in BMI between ACT, and ACT-EX, across the three-time points (baseline, post-intervention (week 6) and follow-up (week 12)).

Hypotheses 2 investigate the differences in BMI between the three groups over the three-time points (baseline, post-intervention (week 6) and follow-up (week 12)). The interaction between time and groups on BMI was significant [F (4, 296) = 5.09, p = .001, η_p^2 = 0.06] with a moderate effect size. The main effect of the three intervention conditions on BMI

was statistically significant [F (2, 148) = 29.45, p = .001, η_p^2 = 0.29] with the ACT and ACT-EX groups showing a greater reduction in BMI across time points than the CG group (Table 4.11).

The main effect comparing the two types of interventions and CG was significant with a moderate effect size [F (2, 149) = 9.89, p = .001 (p < .05), η_p^2 = 0.12] (Table 4.12). Pairwise comparisons (with Bonferroni adjustment) indicated that the BMI was reduced in the ACT and ACT-EX compared to the CG, but the difference was not statistically significant (Table 4.13). Thus, hypothesis 2 was accepted given that there is a significant difference in BMI between ACT, and ACT-EX, across the three time points (baseline, post-intervention (week 6) and follow-up (week 12)).

The ACT and ACT with structured exercise interventions were effective in reducing BMI in the ACT and ACT-EX, respectively, as evident in Figure 4.3. The BMI score was decreased over time in both intervention conditions (ACT and ACT-EX) with a large slope in week six, and the reduction was slightly greater in the ACT-EX condition than in the ACT condition from week six to week 12. Meanwhile, ACT maintained the gain in week 12. The CG declined from week 0 to week 12 on a straight line on a small slope. Tables 4.14 and 4.15 present the descriptive statistics and within-group and between-group effect sizes for the BMI of all groups across the three time points. The within-group effect sizes for ACT (ds = -0.27 and -0.01) and ACT-EX (ds = -0.35 and -0.13) were small from baseline to post-intervention and from post-intervention to follow-up, including the CG (ds = -0.03 and -0.05). The between-group effect sizes for ACT and ACT-EX were also small at post-intervention (d = 0.12) and follow-up (d = 0.25). The effect size between intervention groups and CG were medium to large at post-intervention and follow-up (ACT, d = 0.9 and 0.77; ACT-EX, d = 0.76 and 0.96).

Table 4.11: Multivariate Tests for Main Effect and Interaction Effect Over Time for BMI

Effect	Wilks' Lambda	F	Hypothesis df	Error df	p-value	η_p^2
BMI (main)	.715	29.45	2	148	.001*	.29
BMI*group (interaction over time)	.875	5.09	4	296	.001*	.06

Note. BMI: Body mass index

*Significant level at .05 ($p < .05$)

Table 4.12: Between-Subjects Effects (ACT, ACT-EX and CG) on BMI

Type III Sum of Squares	df	Mean²	F	p-value	η_p^2
1208.30	2	604.15	9.89	.001*	.12

*Significant level at .05 ($p < .05$)

Table 4.13: Pairwise Comparisons between ACT, ACT-EX and CG in BMI

Group (I)	Group (J)	Mean Difference (I-J)	p-value
ACT	ACT-EX	.57	1.00
	CG	-3.15	.002*
ACT-EX	ACT	-.57	1.00
	CG	-3.72	.001*
CG	ACT	3.15	.002*
	ACT-EX	3.72	.001*

*Significant level at .05 ($p < .05$)

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise group, CG: Control group

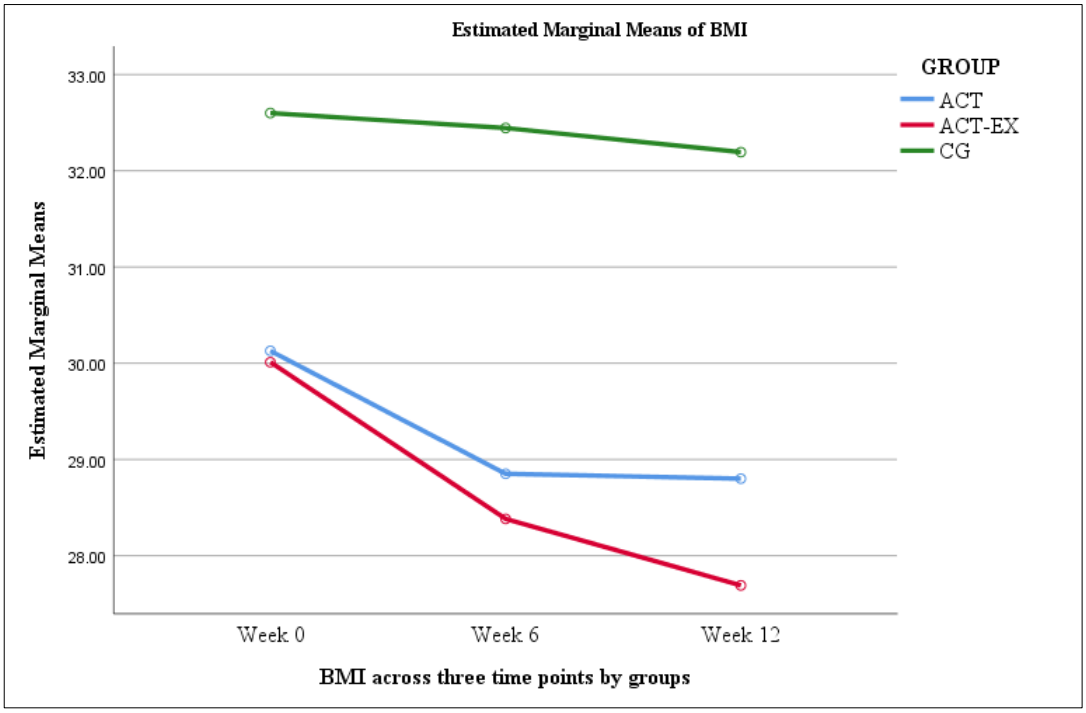


Figure 4.3: Means plot of BMI across the three time points by groups

Table 4.14: Descriptive Statistics for BMI Across the Three Time Points in Three Groups

Measure	Baseline			Post-intervention			Follow-up		
	ACT	ACT-EX	CG	ACT	ACT-EX	CG	ACT	ACT-EX	CG
	Mean (SD)								
BMI	30.13 ± 4.83	30.01 ± 4.63	32.60 ± 4.84	28.85 ± 3.90	28.38 ± 5.36	32.44 ± 4.64	28.80 ± 4.39	27.69 ± 4.71	32.19 ± 5.37

Note. BMI: Body mass index, ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise program group, CG: Control group

Table 4.15: Within-group and Between Group Effect Size for BMI (Cohen's *d*)

		Within-group *d*s		**Between-group *d***		
Variable	**Group**	**Baseline to post-intervention**	**Post-intervention to follow-up**		**Post-intervention**	**Follow-up**
BMI	ACT	-0.27	-0.01	ACT – ACT-EX	0.12	0.25
	ACT-EX	-0.35	-0.13	ACT-EX – CG	0.76	0.96
	CG	-0.03	-0.05	ACT - CG	0.9	0.77

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise program group, CG: Control group, BMI: Body mass index

Positive *d's* indicate increases in score over time and negative *d's* indicate decreases.

4.3.3 Hypothesis 3

Hypothesis 3: There is a significant difference in the mean score of eating behavior (CR, UE, and EE) between ACT, ACT-EX, and CG across the three time points (baseline, post-intervention (week 6) and follow-up (week 12)).

Three subdomains of eating behavior: CR, UE, and EE as measured by TFEQ-18 were considered in this study. The interaction between time and groups on CR was not significant with a small effect size [F (4, 296) = 1.94, p = .10 (p > .05), η_p^2 = 0.03]. The main effect of the three intervention conditions on CR was also not statistically significant, F (2, 148) = 2.20, p =

.12 ($p > .05$), $\eta_p^2 = 0.03$, which was explained by the small effect size (Table 4.16). The CR was not significantly reduced with the ACT and ACT-EX.

The main effect comparing the two types of interventions and CG was not significant with a small effect size [F (2, 149) = 2.47, $p = .09$ ($p > .05$), $\eta_p^2 = 0.03$] (Table 4.17). Pairwise comparisons (with Bonferroni adjustment) also indicated there was no significant difference in the mean difference between the three groups (Table 4.18), suggesting no difference in the effectiveness of the two interventions.

The ACT and ACT-EX has potential in reducing CR as evident in Figure 4.4, even it was not significant. The CR was reduced over time in both conditions (ACT and ACT-EX) from week 0 to week 6. The reduction was greater in the ACT-EX condition with a larger slope than the ACT condition from week six to week 12. The CR increased gradually in the CG as it inclined from week 0 to week six and week 12. Tables 4.19 and 4.20 present the descriptive statistics, as well as within-group and between-group effect sizes for the CR of all groups across the three time points (baseline, post-intervention (week 6) and follow-up (week 12)). The within-group effect sizes for ACT (ds = -0.1 and -0.1) and ACT-EX (ds = -0.08 and -0.13) were small from baseline to follow-up, including the CG (ds = 0.06 and 0.04). The between-group effect sizes for ACT and ACT-EX were also small at post-intervention (d = 0.03) and follow-up (d = 0.3). Likewise, a small and moderate effect size was detected between intervention groups and CG (ACT, d = 0.3 and d = 0.5; ACT-EX, d = 0.3 and 0.7).

Table 4.16: Multivariate Tests for Main Effect and Interaction Effect Over Time for CR Eating Behavior

Effect	**Wilks' Lambda**	**F**	**Hypothesis df**	**Error df**	***p*-value**	η_P^2
CR (main)	.97	2.20	2	148	.12	.03
CR *group (interaction over time)	.95	1.94	4	296	.10	.03

Note. CR: Cognitive restraint

Table 4.17: Between-Subjects Effects (ACT, ACT-EX And CG) On CR Eating Behavior

Type III Sum of Squares	**df**	**Mean²**	**F**	***p*-value**	η_p^2
1.86	2	.93	2.47	.09	.032

Table 4.18: Pairwise Comparisons between ACT, ACT-EX and CG in CR Eating Behavior

(I) Group	**(J) Group**	**Mean Difference (I-J)**	***p*-value**
ACT	ACT-EX-G	.04	1.00
	CG	-.11	.37
ACT-EX	ACT	-.04	1.00
	CG	-.15	.10
CG	ACT	.11	.37
	ACT-EX	.15	.10

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise program group, CG: Control group

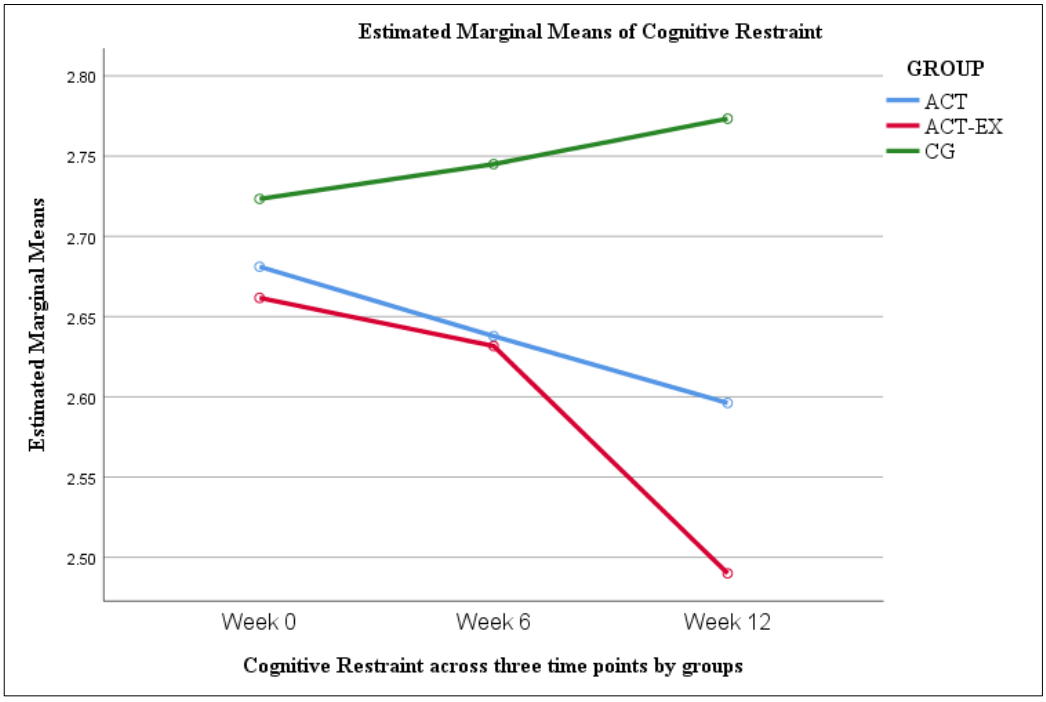


Figure 4.4: Means plot of CR across the three time points by groups

Table 4.19: Descriptive Statistics for All CR Eating Behavior Across the Three Time Points

Measure	Baseline			Post-intervention			Follow-up		
	ACT	ACT-EX	CG	ACT	ACT-EX	CG	ACT	ACT-EX	CG
	Mean (SD)								
CR	2.68 ± 0.41[a]	2.66 ± 0.38[a]	2.72 ± 0.49	2.64 ± 0.35	2.63 ± 0.46	2.75 ± 0.54	2.60 ± 0.37	2.49 ± 0.42	2.77 ± 0.47

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise program group, CG: Control group

[a]*p*-value difference between ACT, ACT-EX and CG (One-way ANOVA's post-hoc test revealed > .05).

Table 4.20: Within-group and Between Group Effect Size for CR (Cohen's *d*)

Variable	Group	Within-group *d*s		Between-group *d*		
		Baseline to post-intervention	**Post-intervention to follow-up**		**Post-intervention**	**Follow-up**
CR	ACT	-0.1	-0.11	ACT – ACT-EX	0.03	0.3
	ACT-EX	-0.08	-0.3	ACT-EX – CG	0.3	0.7
	CG	0.06	0.04	ACT - CG	0.3	0.5

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise program group, CG: Control group, CR: Cognitive restraint

Positive *d's* indicate increases in score over time and negative *d's* indicate decreases.

Further analysis on UE found that the interaction between time and groups was significant with a small effect size [F (4, 296) = 4.121, p = .003 (p < .05), η_p^2 = 0.05]. The main effect of the three intervention conditions on UE was statistically significant with large effect size [F (2, 148) = 16.84, p = .001 (p < .05), η_p^2 = 0.19] with the two groups, ACT and ACT-EX, demonstrating a reduction in UE across the three time points (baseline, post-intervention (week 6) and follow-up (week 12)) (Table 4.21).

The main effect comparing the two types of interventions and CG was not significant with a small effect size [F (1, 149) = 1.13, p = .33 (p > .05), η_p^2 = 0.02] (Table 4.22). Pairwise

comparisons (with Bonferroni adjustment) indicated that UE was greater in the CG compared to the ACT and ACT-EX with no significant difference (Table 4.23).

The ACT and ACT-EX interventions were effective in reducing UE as evident in Figure 4.5. The UE score was reduced over time in both conditions (ACT and ACT-EX) in week 6 with large slopes, and the reduction was greater in the ACT condition than in the ACT-EX condition from week 0 to week 6. However, the UE score was reduced more in ACT-EX from week six to week 12 than in ACT, with the slope appearing smaller than the baseline to week six. The CG appeared inconsistent in UE depicting a rising trend from week 0 to week six before falling suddenly at week 12. Tables 4.24 and 4.25 present the descriptive statistics and within-group and between-group effect sizes for the UE of all groups across the three time points (baseline, post-intervention (week 6) and follow-up (week 12)). The within-group effect sizes for ACT were medium from baseline to post-intervention (*d*s = -0.9) and small in post-intervention to follow-up (*d*s = -0.1). On the other hand, the effect sizes were small for ACT-EX from baseline to follow-up (*ds* = -0.34 and -0.2). The between-group effect sizes for ACT and ACT-EX were small at post-intervention (*d* = 0.09) and at follow-up (*d* = 0.18). Similarly, the between-group effect sizes were small for ACT-EX and CG (*d* = 0.3 and *d* = 0.32), and between ACT and CG (*d* = 0.35 and *d* = 0.16) at post-intervention and follow-up.

Table 4.21: Multivariate Tests for Main Effect and Interaction Effect Over Time for UE

Effect	**Wilks' Lambda**	***F***	**Hypothesis df**	**Error df**	***p*-value**	η_p^2
UE (main)	.815	16.84	2	148	.001*	.19
UE*group (interaction over time)	.897	4.121	4	296	.003*	.05

Note. UE: Uncontrolled eating

*Significant is at .05 ($p < .05$)

Table 4.22: Between-Subjects Effects (ACT, ACT-Ex and CG) on UE Eating Behavior

Type III Sum of Squares	**df**	**Mean²**	**F**	***p*-value**	η_p^2
.842	2	.421	1.125	.327	.02

Table 4.23: Pairwise Comparisons between ACT, ACT-EX and CG in UE

(I) Group	**(J) Group**	**Mean Difference (I-J)**	**p-value**
ACT	ACT-EX	.08	.77
	CG	-.02	1.00
ACT-EX	ACT	-.08	.77
	CG	-.10	.48
CG	ACT	.02	1.00
	ACT-EX	.10	.48

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise program group, CG: Control group, UE: Uncontrolled eating

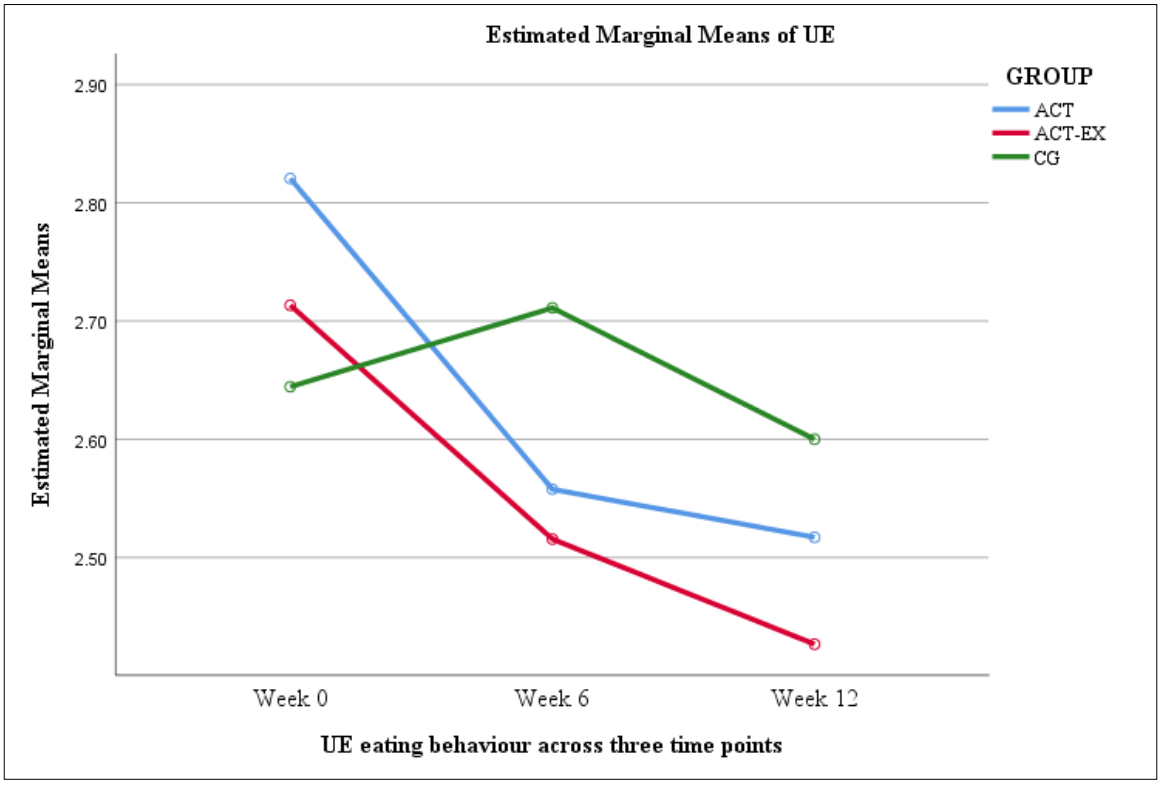


Figure 4.5: Means Plot of UE Eating Behavior accross the Three-Time Points By Groups

Table 4.24: Descriptive Statistics for UE across the Three-Time Points

Measure	Baseline			Post-intervention			Follow-up		
	ACT	ACT-EX	CG	ACT	ACT-EX	CG	ACT	ACT-EX	CG
	Mean (± *SD*)								
UE	2.82 ± 0.30[a]	2.71 ± 0.53[a]	2.64 ± 0.40[a]	2.56 ± 0.43	2.52 ± 0.57	2.71 ± 0.40	2.52 ± 0.50	2.43 ± 0.53	2.60 ± 0.39

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise program group, CG: Control group, UE: Uncontrolled eating

[a]*p*-value difference between ACT, ACT-EX and CG (One-way ANOVA revealed > .05).

Table 4.25: Within-group and between group effect size for UE Eating Behavior (Cohen's *d*)

		Within-group *d*s		**Between-group *d***		
Variable	**Group**	**Baseline to post-intervention**	**Post-intervention to follow-up**		**Post-intervention**	**Follow-up**
UE	ACT	-0.9	-0.1	ACT – ACT-EX	0.09	0.18
	ACT-EX	-0.34	-0.16	ACT-EX – CG	0.3	0.32
	CG	0.18	-0.28	ACT - CG	0.35	0.16

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise program group, CG: Control group, UE: Uncontrolled eating

Positive *d's* indicate increases in score over time and negative *d's* indicate decreases.

Similar analysis was conducted to assess changes of EE by groups in three time points (baseline, post-intervention (week 6) and follow-up (week 12)). The interaction between time and groups on EE was not significant with a moderate effect size [F (4, 296) = 1.20, p = 0.31 (p > .05), η_p^2 = 0.06]. The main effect of three conditions on EE was statistically significant with a moderate effect size [F (2, 148) = 11.34, p = .001 (p < .05), η_p^2 = 0.13], with the ACT and ACT-EX-G demonstrating a reduction in EE across the three time points (baseline, post-intervention (week 6) and follow-up (week 12)) (Table 4.26).

The main effect was significant with a large effect size when comparing the two types of interventions and CG [F (2, 149) = 16.73, p = .001 (p < .05), η_p^2 = 0.18] (Table 4.27). Pairwise comparisons (with Bonferroni adjustment) indicated that EE reduced greater in the ACT and ACT-EX than in the CG, but the difference was not statistically significant (Table 4.28).

The ACT and ACT-EX interventions were effective in reducing EE as evident in Figure 4.6. The EE was reduced over time in both intervention conditions (ACT and ACT-EX) at week six with large slopes, and the reduction was slightly greater in the ACT-EX condition than in the ACT condition. However, the slope appeared smaller from week six to week 12 for both intervention groups. The CG appeared to rise from week 0 to Week 12 in a straight line. Tables 4.29 and 4.30 present the descriptive statistics and within-group and between-group effect sizes for the EE in all the groups across the three time points. The within-group effect sizes for ACT (ds = -0.58 and 0) and ACT-EX (ds = -0.35 and -0.04) were small from baseline to follow-up, including the CG (ds = -0.56 and 0.35). Similar results were observed for the between-group effect sizes for ACT and ACT-EX at post-intervention (d = 0.1) and follow-up (d = 0.04). Likewise, the effect sizes between the intervention groups and CG were medium to large (ACT, d = 0.53 and d = 0.9) and small to medium (ACT-EX, d = 0.3 and d = 0.6).

Table 4.26: Multivariate tests for main effect and interaction effect over time for EE

Effect	**Wilks' Lambda**	***F***	**Hypothesis df**	**Error df**	***p*-value**	η_p^2
EE (main)	.867	11.34	2	148	.001*	.13
EE*group (interaction over time)	.968	1.20	4	296	.31	.02

Note. EE: Emotional eating

*Significant is at .05 ($p < .05$)

Table 4.27: Between-subjects effects (ACT, ACT-EX and CG) on EE

Type III Sum of Squares	**df**	**Mean²**	***F***	***p*-value**	η_p^2
16.25	2	8.12	16.73	.001*	.18

*Significant is at .05 ($p < .05$)

Table 4.28: Pairwise Comparisons between ACT, ACT-EX and CG in EE

(I) Group	**(J) Group**	**Mean Difference (I-J)**	***p*-value**
ACT	ACT-EX	-.07	1.00
	CG	-.43	.001*
ACT-EX	ACT	.07	1.00
	CG	-.36	.001*
CG	ACT	.43	.001*
	ACT-EX	.36	.001*

Table 4.28 continued

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise program group, CG: Control group

*Significant is at .05 ($p < .05$)

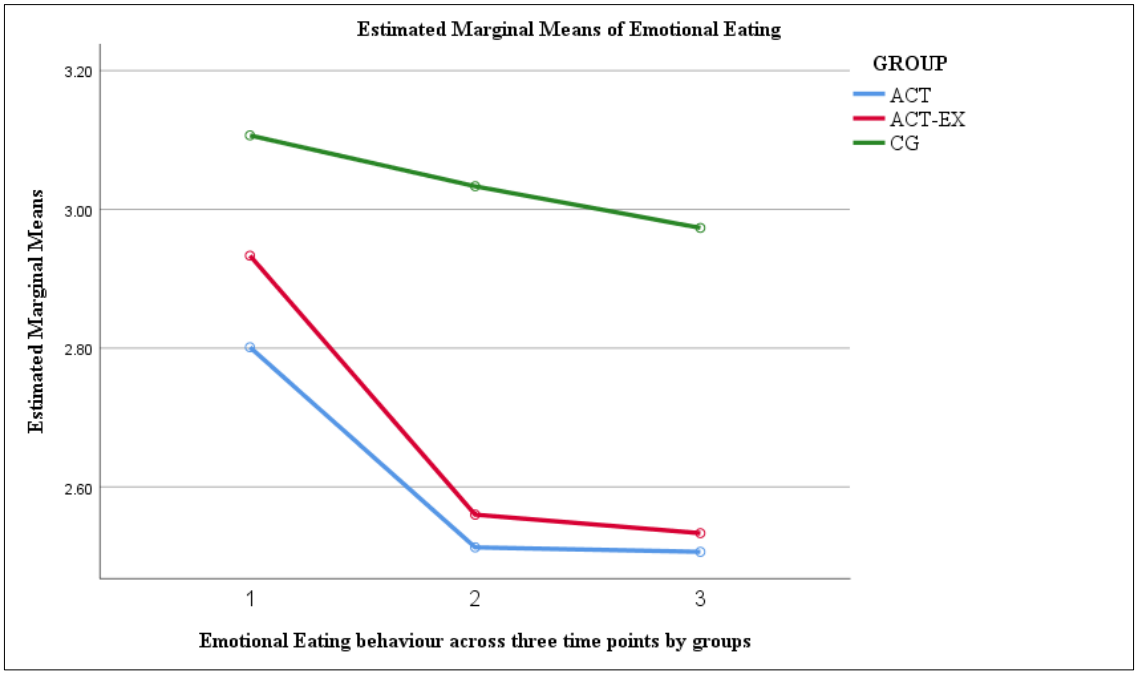


Figure 4.6: Means plot of EE Eating Behavior across the Three Time Points By Groups

Table 4.29: Descriptive Statistics for EE Eating Behavior Across the Three Time Points

Measure	Baseline			Post-intervention			Follow-up		
	ACT	ACT-EX	CG	ACT	ACT-EX	CG	ACT	ACT-EX	CG
	Mean (± *SD*)								
EE	2.80 ± 0.50[a]	2.933 ± 0.75[a]	3.11 ± 0.55	2.51 ± 0.55	2.56 ± 0.81	2.80 ± 0.49	2.51 ± 0.53	2.53 ± 0.76	2.97 ± 0.66

Table 4.29 continued

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise program group, CG: Control group, EE: Emotional eating

[a]*p*-value difference between ACT and ACT-EX group (One-way ANOVA's post-hoc test revealed > .05).

Table 4.30: Within-group and Between Group Effect Size for EE (Cohen's *d*)

Variable	**Group**	**Within-group *d*s**		**Between-group *d***		
		Baseline to post-intervention	**Post-intervention to follow-up**		**Post-intervention**	**Follow-up**
EE	ACT	-0.58	0	ACT – ACT-EX	0.1	0.04
	ACT-EX	-0.35	-0.04	ACT-EX – CG	0.3	0.6
	CG	-0.56	0.35	ACT - CG	0.53	0.9

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise program group, CG: Control group, EE: Emotional eating.

Positive *d's* indicate increases in score over time and negative *d's* indicate decreases.

From the analysis on eating behavior subscales, there are no significant differences in CR and UE between ACT, ACT-EX and CG. The EE revealed a significant difference between

the ACT, ACT-EX and CG. Thus, Hypothesis 3 is accepted since there is some significant difference in the mean score of eating behavior (CR, UE, and EE as measured by TFEQ-18) between ACT, ACT-EX, and CG across the three time points (baseline, post-intervention (week 6) and follow-up (week 12)).

4.3.4 Hypothesis 4

Hypothesis 4: There is a significant difference in the mean score of defense styles (mature, immature and neurotic defense style) between ACT, ACT-EX, and CG across the three time points (baseline, post-intervention (week 6) and follow-up (week 12)).

The interaction of time and group on mature defense style was found to be significant with a moderate effect size [F (4, 296) = 4.201, p = .003 (p < .05), η_p^2 = 0.05]. The main effect of three intervention conditions on mature defense style was also statistically significant with a large effect size [F (2, 148) = 9.48, p = .001 (p < .05), η_p^2 = 0.11], with two groups: ACT and ACT-EX showed an increment across the three time (baseline, post-intervention (week 6) and follow-up (week 12)) (Table 4.31).

The main effect comparing the two types of interventions and CG was not significant with a corresponding small effect size [F (2, 149) = 2.24, p = .110 (p > .05), η_p^2 = 0.03] (Table 4.32). Pairwise comparisons (with Bonferroni adjustment) indicated that mature defense style increased slightly greater in the ACT and ACT-EX than CG, but the difference was not statistically significant (Table 4.33).

The ACT and ACT-EX interventions were effective in increasing mature defense, style as evident in Figure 4.7. The mature defense style was increased over time in both intervention conditions (ACT and ACT-EX) in week six, and the increment was slightly greater in the ACT condition than in the ACT-EX condition. Furthermore, the slope appears larger from week six

to week 12 for both intervention groups. The CG appeared inclined from baseline to week six and slightly increased until week 12. Tables 4.34 and 4.35 depict the descriptive statistics and within-group and between-group effect sizes for the mature defense style of all groups across the three time points. The within-group effect sizes for ACT (*d*s = -0.07 and *ds* = -0.01) and ACT-EX (*d*s = -0.04 and *ds* = -0.11) were small from baseline to post-intervention and follow-up, including the CG (*d*s = 0.06 and 0.03). The between-group effect sizes for ACT and ACT-EX were also small at post-intervention (*d* = 0.3) and moderate at follow-up (*d* = 0.6). The effect size between ACT and CG was medium (*d* = 0.5 and *d* = 0.6), while ACT-EX and CG was small (*d* = 0.03 and *d* = 0.04) at post-intervention and follow-up.

Table 4.31: Multivariate Tests for Main Effect and Interaction Effect Over Time for Mature Defense Style

Effect	**Wilks' Lambda**	***F***	**Hypothesis df**	**Error df**	***p*-value**	η_p^2
Mat_DS (main)	.886	9.48	2	148	.001*	.11
Mat_DS*group (interaction over time)	.895	4.20	4	296	.003*	.05

Note. Mat_DS: Mature defense style

*Significant is at .05 ($p < .05$)

Table 4.32: Between-Subjects Effects (ACT, ACT-EX And CG) on Mature Defense Style

Type III Sum of Squares	**df**	**Mean²**	***F***	***p*-value**	η_p^2
17.07	2	8.35	2.24	.110	.03

Table 4.33: Pairwise Comparisons between ACT, ACT-EX and CG in Mature Defense Style

(I) Group	(J) Group	Mean Difference (I-J)	*p*-value
ACT	ACT-EX	.19	1.00
	CG	.47	.11
ACT-EX	ACT	-.19	1.00
	CG	.28	.63
CG	ACT	-.47	.11
	ACT-EX	-.28	.63

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise program group, CG: Control group

*Significant is at .05 ($p < .05$)

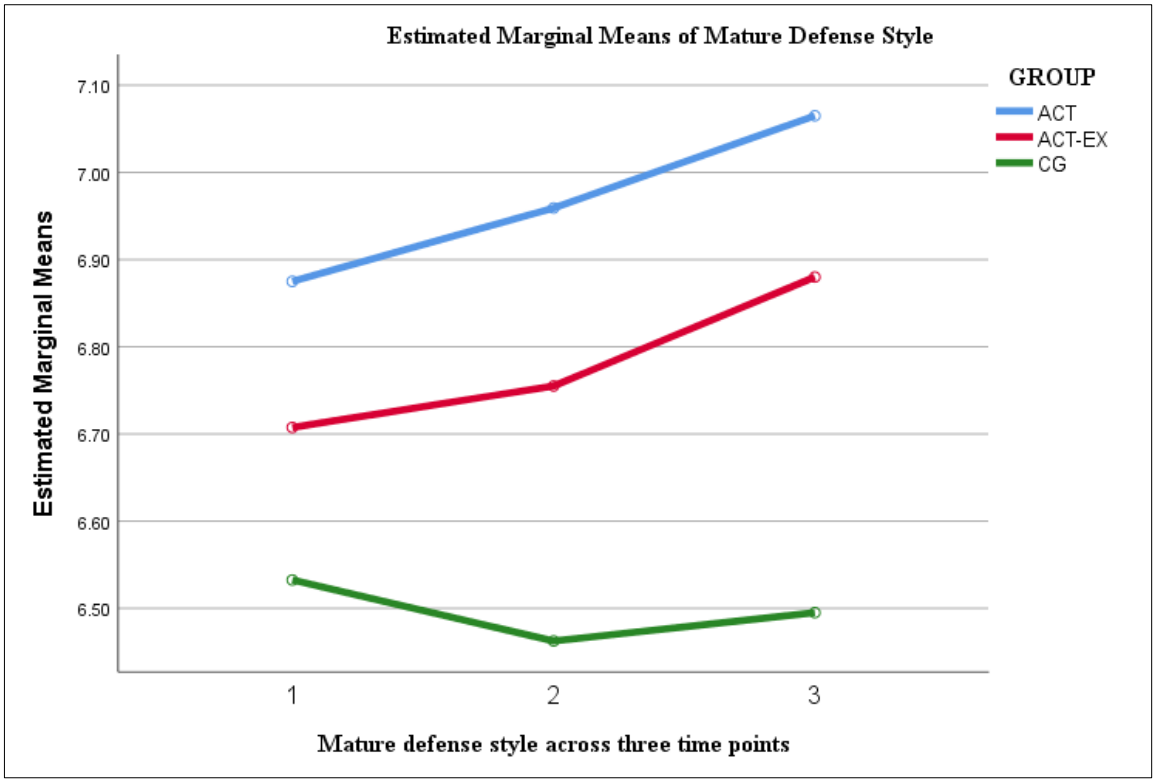


Figure 4.7: Means plot of Mature Defense Style across the Three Time Points By Groups

Table 4.34: Descriptive Statistics for Mature Defense Style across the Three Time Points

Measure	Baseline			Post-intervention			Follow-up		
	ACT	ACT-EX	CG	ACT	ACT-EX	CG	ACT	ACT-EX	CG
	Mean (± *SD*)								
Mat_DS	6.88 ± 1.13	6.71 ± 1.14	6.53 ± 1.27	6.96 ± 1.12	6.76 ± 1.13	6.46 ± 1.21	7.06 ± 1.01	6.88 ± 1.06	6.50 ± 1.17

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise program group, CG: Control group, Mat_DS: Mature defense style

Table 4.35: Within-Group and Between Group Effect Size for Mature Defense Style (Cohen's *d*)

Variable	Group	Within-group *d*s		Between-group *d*		
		Baseline to post-intervention	Post-intervention to follow-up		Post-intervention	Follow-up
Mat_DS	ACT	0.07	0.1	ACT – ACT-EX	0.3	0.6
	ACT-EX	0.04	0.2	ACT-EX – CG	0.3	0.4
	CG	-0.06	0.03	ACT - CG	0.5	0.6

Table 4.35 continued

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise program group, CG: Control group, Mat_DS: Mature defense style.
Positive *d's* indicate increases in score over time and negative *d's* indicate decreases.

The next analysis was conducted on immature defense style changes by groups and three time points (baseline, post-intervention (week 6) and follow-up (week 12)). The interaction between time and groups on immature defense style was significant with a moderate effect size [F (4, 296) = 8.14, p = .001, η_p^2 = 0.10]. The main effect of the three intervention conditions on immature defense style was statistically significant with moderate effect size *[F* (2, 148) = 121.75, p = .001, η_p^2 = 0.12], with two groups: ACT and ACT-EX, reflecting a decline across the three time points (baseline, post-intervention (week 6) and follow-up (week 12)) (Table 4.36).

The main effect comparing the two types of interventions and CG was significant with a large effect size [F (2, 149) = 24.27, p = .001 (p < .05), η_p^2 = 0.25] (Table 4.37). There is a significant difference was detected in the immature defense style between ACT, ACT-EX, and CG across the three periods. Pairwise comparisons (with Bonferroni adjustment) indicated that immature defense style was not significantly different between ACT and ACT-EX, but a significant difference was observed between ACT and ACT-EX with CG (Table 4.38).

The ACT and ACT-EX interventions were effective in reducing immature defense style as evident in Figure 4.8. The immature defense style decreased over time in both intervention conditions (ACT and ACT-EX) in week six, and the trend was slightly greater in the ACT condition than in the ACT-EX condition with a large slope. Furthermore, the slope was reduced

from week six to week 12 for both intervention groups. The CG appeared to decline from week 0 to week six and slightly incline until week 12. Tables 4.39 and 4.40 present the descriptive statistics and within-group and between-group effect size for the immature defense style of all groups across the three time points. The within-group effect sizes for ACT (*d*s = -2.1) and ACT-EX (*d*s = -1.51) were large from baseline to post-intervention but moderate in the CG (*d*s = -0.81). In the post-intervention to follow-up, the effect sizes were small in all groups; ACT, *d*s = -0.25, ACT-EX, *d* = -0.1 and CG, *d* = 0.16. On the other hand, the between-group effect sizes for ACT and ACT-EX were small at post-intervention (*d* = 0.09) and at follow-up (*d* = 0.07). Furthermore, the effect size between ACT-EX and CG was large (*d* = 1.02), while ACT and CG were also large (*d* = 0.95). At follow-up, both the interventions and control groups had large effect sizes (ACT, *d* = 0.95 and *d* = 1.4; ACT-EX, *d* = 1.02 and *d* = 1.2).

Table 4.36: Multivariate Tests for Main Effect and Interaction Effect Over Time for Immature Defense Style

Effect	**Wilks' Lambda**	***F***	**Hypothesis df**	**Error df**	***p*-value**	η_p^2
Imm_DS (main)	.378	121.75	2	148	.001*	.62
Imm_DS*group (interaction over time)	.812	8.14	4	296	.00*	.10

Note. Imm_DS: Immature defense style

*Significant is at .05 ($p < .05$)

Table 4.37: Between-Subjects Effects (ACT, ACT-EX And CG) on Immature Defense Style)

Type III Sum of Squares	**df**	**Mean²**	***F***	***p*-value**	η_p^2
90.12	2	45.06	24.27	.001*	.23

Table 4.38: Pairwise Comparisons between ACT, ACT-EX and CG in Immature defense style

(I) Group	(J) Group	Mean Difference (I-J)	*p*-value
ACT	ACT-EX	.08	.878
	CG	-.91	.001*
ACT-EX	ACT	-.08	.878
	CG	-.98	.001*
CG	ACT	.91	.001*
	ACT-EX	.98	.001*

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise program group, CG: Control group

*Significant is at .05 ($p < .05$)

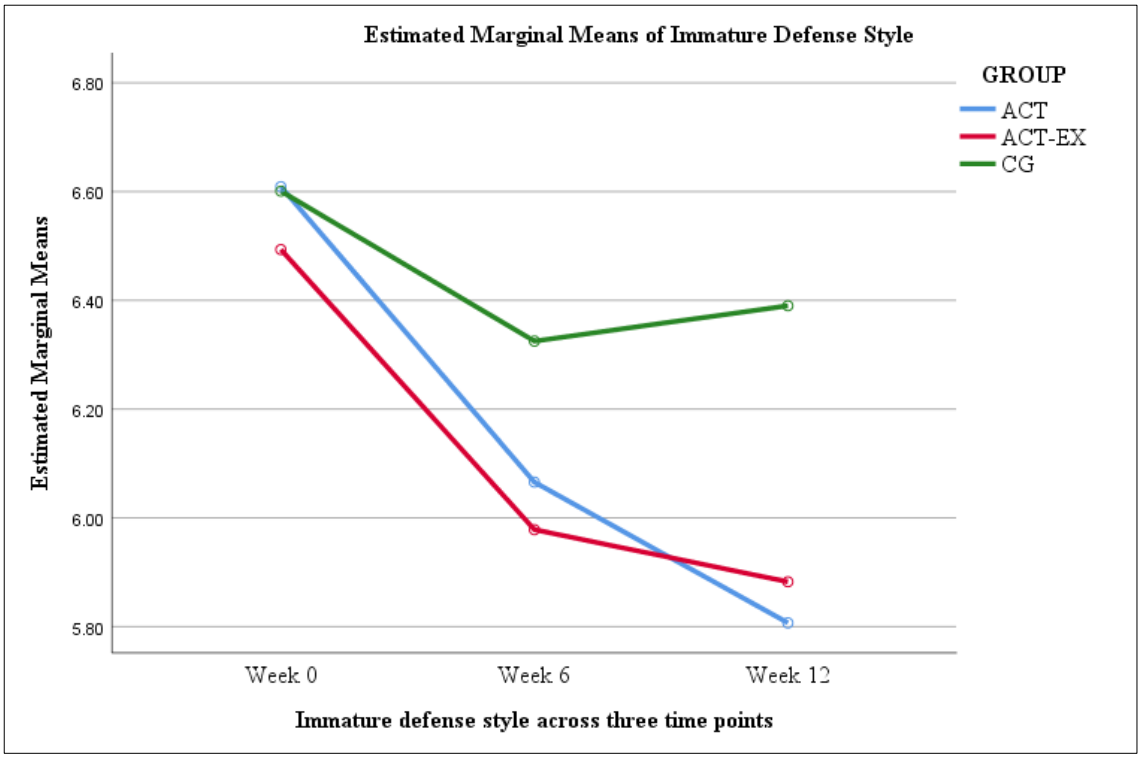


Figure 4.8: Means plot of Immature defense style across the Three Time Points By Groups

Table 4.39: Descriptive statistics for Immature Defense Style Across the Three Time Points

Measure	Baseline			Post-intervention			Follow-up		
	ACT	ACT-EX	CG	ACT	ACT-EX	CG	ACT	ACT-EX	CG
	Mean (SD)								
Imm_DS	7.32 ± 0.59	7.11 ± 0.75	7.65 ± 0.74	6.07 ± 1.03	5.98 ± 1.05	7.05 ± 1.07	5.81 ± 1.01	5.88 ± 1.08	7.22 ± 1.01

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise program group, CG: Control group, Imm_DS: Immature defense style

Table 4.40: Within-group and Between Group Effect Size for Immature Defense Style (Cohen's *d*)

Variable	Group	Within-group *d*s		Between-group *d*		
		Baseline to post-intervention	Post-intervention to follow-up		Post-intervention	Follow-up
Imm_DS	ACT	2.1	0.25	ACT – ACT-EX	0.59	0.16
	ACT-EX	1.51	0.09	ACT-EX – CG	0.7	0.25
	CG	0.81	-0.16	ACT - CG	1.29	0.41

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise program group, CG: Control group, Imm_DS: Immature defense style.

Positive *d's* indicate increases in score over time and negative *d's* indicate decreases.

The analysis for the third neurotic defense style found that the interaction between time and groups on neurotic defense style was significant with a large effect size [F (4, 296) = 22.32, p = .001, η_p^2 = 0.23]. The main effect of three conditions on neurotic defense style was statistically significant with large effect size [F (2, 148) = 107.38, p = .001, η_p^2 = 0.59], with two groups: ACT and ACT-EX reflecting a decline across the three time points (baseline, post-intervention (week 6) and follow-up (week 12)) (Table 4.41).

The main effect comparing the two types of interventions and CG was significant with a large effect size [F (2, 149) = 34.05, p = .001 (p < .05), η_p^2 = 0.31] (Table 4.42). There is a significant difference was detected in the neurotic defense style between ACT, ACT-EX, and CG across the three periods. Pairwise comparisons (with Bonferroni adjustment) indicated that neurotic defense style was significantly different between ACT and ACT-EX, but a significant difference was recorded between ACT and ACT-EX with CG (Table 4.43).

The ACT and ACT-EX interventions were effective in reducing the neurotic defense style as reflected in Figure 4.9. The neurotic defense style decreased over time in both conditions (ACT and ACT-EX) at week six with a large slope. Furthermore, the slope was reduced from week six to week 12 for both intervention groups. The CG appeared slightly inclining from week 0 to week six and slightly declining to week 12. Tables 4.44 and 4.45 present the descriptive statistics and within-group and between-group effect sizes for the neurotic defense style of all groups across the three time points. The within-group effect sizes for ACT (ds = -2.6) and ACT-EX (ds = -2.2) were large from baseline to post-intervention but small from post-intervention to follow-up (ACT, ds= -0.6; ACT-EX, ds= -0.86), whereas that of the CG appeared small from baseline to follow-up (ds = 0.06 and -0.24). The between-group effect sizes for ACT and ACT-EX were also small at post-intervention (d = 0.27) and follow-up (d = 0.35) while the effect sizes between both ACT-EX (d = 1.46) and ACT (d = 1.2) and

CG were large at post-intervention. Both intervention groups and CG recorded a large effect size at follow-up (ACT, $d = 1.3$; ACT-EX, $d = 1.37$).

Table 4.41: Multivariate Tests for Main Effect and Interaction Effect Over Time for Neurotic Defense Style

Effect	**Wilks' Lambda**	***F***	**Hypothesis df**	**Error df**	***p*-value**	η_p^2
Neu_DS (main)	.408	107.38	2	148	.001*	.59
Neu_DS*group (interaction over time)	.590	22.32	4	296	.001*	.23

Note. Neu_DS: Neurotic defense style

*Significant is at .05 ($p < .05$)

Table 4.42: Between-Subjects Effects (ACT, ACT-EX And CG) On Neurotic Defense Style

Type III Sum of Squares	**df**	**Mean²**	***F***	***p*-value**	η_p^2
128.431	2	64.22	34.05	.001*	.31

*Significant is at .05 ($p < .05$)

Table 4.43: Pairwise Comparisons between ACT, ACT-EX and CG in Neurotic Defense Style

(I) Group	**(J) Group**	**Mean Difference (I-J)**	**p-value**
ACT	ACT-EX	.13	1.00
	CG	-1.06	.001*
ACT-EX	ACT	-.13	1.00
	CG	-1.19	.001*
CG	ACT	1.06	.001*
	ACT-EX	1.19	.001*

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise program group, CG: Control group

*Significant is at .05 ($p < .05$)

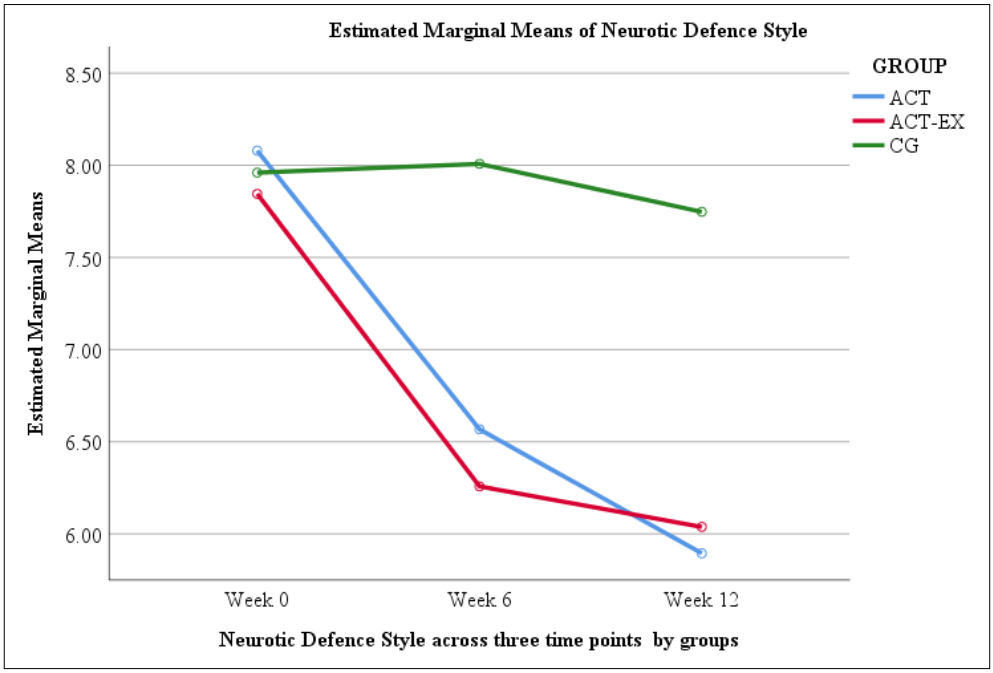


Figure 4.9: Means plot of Neurotic defense style across the three time points by groups

Table 4.44: Descriptive Statistics for Neurotic Defense Style Across the Three Time Points

Measure	Baseline			Post-intervention			Follow-up		
	ACT	ACT-EX	CG	ACT	ACT-EX	CG	ACT	ACT-EX	CG
	Mean (SD)								
Neu_DS	8.08 ± 0.59	7.85 ± 0.72	7.96 ± 0.88	6.57 ± 1.14	6.26 ± 1.20	8.01 ± 1.08	5.89 ± 1.43	6.04 ± 1.25	7.75 ± 1.05

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise program group, CG: Control group, Neu_DS: Neurotic defense style

Table 4.45: Within-Group Effect Size for Neurotic Defense Style (Cohen's *d*)

Variable	**Group**	**Within-group *d*s**		**Between-group *d***		
		Baseline to post-intervention	**Post-intervention to follow-up**		**Post-intervention**	**Follow-up**
Neu_DS	ACT	-2.6	-0.6	ACT – ACT-EX	0.27	0.35
	ACT-EX	-2.2	-0.86	ACT-EX – CG	1.46	1.37
	CG	0.06	-0.24	ACT - CG	1.2	1.3

Note. ACT: Acceptance and commitment therapy group, ACT-EX: Acceptance and commitment therapy and structured exercise program group, CG: Control group, Neu_DS: neurotic defense style.

Positive *d's* indicate increases in score over time and negative *d's* indicate decreases.

From the analysis on defense styles, there is no significant difference in mature defense style between ACT, ACT-EX and CG. However, immature and neurotic defense style revealed significant differences between ACT, ACT-EX and CG. Thus, Hypothesis 4 is accepted since there are some significant differences in the mean score of defense styles (immature and neurotic) between ACT, ACT-EX, and CG across the three time points (baseline, post-intervention (week 6) and follow-up (week 12)).

4.4 Summary

An RCT was performed to evaluate the effectiveness of ACT and ACT-EX on WRF (measured by the AAQW-R18 score), BMI, eating behavior (CR, UE, and EE), and

psychological defense styles among overweight and obese university students (N = 152). They were randomly assigned to one of three conditions: ACT (n = 52), ACT-EX (n = 50), or CG (n = 50). The response rate was 100% due to the feasibility of the intervention, which involved six sessions (once a week for six weeks) of videoconferencing. The objectives of the study were accomplished, and the hypotheses were tested.

The results found that both ACT and ACT-EX were effective in improving WRF, BMI, eating behavior, and defense styles in OW/OB university students over a period of 12 weeks divided into three time points: baseline (week 0), post-intervention (week 6) and follow-up (week 12). Between weeks 0 and six, the ACT-EX was more effective in improving WRF than the ACT alone. The ACT maintained its gain during week 12, whereas the ACT-EX continued to improve. There was a significant difference in the effects of ACT and ACT-EX on WRF across the three time points. From week 0 to week six, BMI was effectively reduced in both ACT and ACT-EX, which was maintained in the ACT from week six to week 12 of follow-up. Meanwhile, the BMI was further reduced in the ACT-EX in the follow-up week. Between the three time points, a significant difference was detected in the effects of ACT and ACT-EX on BMI.

In this study, three subscales of the TFEQ-18 were used to assess eating behavior. The CR eating behavior decreased from week 0 to week six in both the ACT and ACT-EX conditions and continued to decrease dramatically until week 12 in the ACT-EX condition. Across the three time points, no significant difference was observed in the effects of ACT and ACT-EX on CR. For UE, both conditions were effective from week 0 to week six and subsequent follow-up. However, no significant difference was recorded in the effects of ACT and ACT-EX on the UE across the three points (baseline, post-intervention (week 6) and follow-up (week 12)). The third subscale, EE was noticeably lowered in both intervention

groups from week 0 to week six, and it was further reduced until week 12 with a slightly higher drop in the ACT. In week 12, the ACT-EX maintained its EE mean score. Nevertheless, no significant difference was detected in the effects of ACT and ACT-EX on EE across the three time points (baseline, post-intervention (week 6) and follow-up (week 12)).

Furthermore, three types of defense styles were examined in this study: mature, immature, and neurotic. From week 0 to week six, the mature defense style increased in both intervention conditions with a greater slope in the ACT than in ACT-EX. The gain was maintained in both intervention conditions from week six to week 12. No significant difference was detected in the effect of ACT and ACT-EX on mature defense style across the three time points. However, the immature defense style reduced significantly with time in both intervention conditions in week six. Additionally, the slope was large in week six compared to week 12 for both intervention groups. A significant difference was observed in the immature defense style in the ACT and ACT-EX between the three time points. Both ACT and ACT-EX interventions were successful in reducing immature defense styles. From week 0 to week six, the neurotic defense style declined significantly in both intervention conditions. Likewise, the slope was reduced in both intervention groups between week six and week 12. Across the three periods, there was no significant difference in the effect of ACT and ACT-EX on the neurotic defense style. The aforementioned results will be further discussed in the next chapter.

CHAPTER 5

DISCUSSION

The key findings of this study are reviewed in this chapter. The discussion of the Phase 1 study, which comprised conducting a prevalence study of overweight and obese university students, is where it all starts. Phase 1 aim:

To determine the prevalence of obesity and overweight among university students during the COVID-19 pandemic.

The Phase 2 Study was followed, with the aim to achieve the following three objectives:

1. to examine the effectiveness of ACT on WRF (measured by AAQW-R18 scores), BMI, eating behavior (CR, UE, and EE), and defense styles (mature, immature, and neurotic) of the overweight and obese university students
2. to examine the effectiveness of ACT and ACT-EX on WRF, BMI, eating behavior (CR, UE, and EE), and defense styles (mature, immature and neurotic) of the overweight and obese university students
3. to compare the effect of ACT and ACT-EX on WRF, BMI, eating behavior (CR, UE, and EE), and defense styles (mature, immature and neurotic) of the overweight and obese university students.

These objectives are discussed further, along with significant practical implications and whether or not they were supported. This study contributes significantly to elucidating the effectiveness of structured exercise and ACT for overweight and obese university students. The contribution of the findings to the existing body of knowledge is considered. The study's overall limitations are discussed at the conclusion, along with potential areas for further study.

To date, the effectiveness of ACT in WRF and enhancing eating behavior and BMI among overweight and obese university students has not been investigated. Thus, the present study is the first attempt to fill the aforementioned research gap, particularly among university students with remarkable immature and neurotic defense styles. The main hypothesis is that ACT and ACT-EX would be more effective than CG in improving WRF, BMI, eating behavior and defense styles were confirmed.

5.1 Prevalence of Overweight and Obesity among University Students

In the first phase of this study, the prevalence of OW/OB in the studied population from two public universities in Sarawak was assessed. The prevalence of 14.31% and 10.13 % based on WHO categorization were lower than the respective Asian cut-off points of 22.19% and 16.88%, respectively. The hypothesis posits that the prevalence of both outcomes based on the WHO's classification would be lower compared to the cut-off values for the Asian population given that the latter used a lower value. However, the prevalence of obesity and overweight in the studied population was exceptionally high (39.1%) according to the Asian cut-off value. This prevalence estimate is higher relative to the reports among Malaysian university students before the COVID-19 pandemic, in which 21.2% and 16.3% were overweight and obese, respectively (Wan Mohamed Radzi et al., 2019). Tan et al. (2021) found a similar trend among Indonesian and Malaysian university students as they gained significant weight during the first trimester of confinement following the pandemic.

In the current study, a greater proportion of Malaysian university students were overweight or obese than university students in Saudi Arabia (33.3% in June 2020) (Jalal et al., 2021), Southern Morocco (26.4% in March/June 2020) (Boukrim et al., 2021), and China (32.3% in April/May 2020) (Jia et al., 2021). Physical activity might have been drastically reduced as students were confined and restricted as the government implemented the movement

control order (RMCO). During RMCO, it is likely to have an indirect effect on physical activity, causing students to burn fewer calories and gain weight.

Adapting to a new environment and culture is common in young adults as they experience a transitional period during their university education. Students face several challenges in adjusting their lifestyle during the pandemic, which is further compounded by prolonged hours of sedentary teleconference assignments and lectures (Martínez-de-Quel et al., 2021). Students gain significant weight due to sedentary lifestyle and are more likely to become OW/OB if the weight gain is not addressed. Weight gain is common among university students during the course of their education (Deliens et al., 2014). Factors promoting weight gain in these students during the pandemic include emotional eating and physical inactivity due to increased sedentary lifestyle from sitting at home for online lectures (Kriaucioniene et al., 2020; Reyes-Olavarría et al., 2020).

Male students recorded a significantly higher mean BMI relative to female students in all age groups. Among male participants, students aged 24 years and older had a significantly higher mean BMI compared to the younger students. The three age groups' mean values fell into the overweight and obese categories. The BMI mean values in the normal weight category, however, were distributed similarly across female students. Comparisons between the female and male students revealed a significant difference in the BMI prevalence across age groups according to the WHO and Asian cut-off criteria. Based on the WHO classification, male students reflected a higher prevalence of OW/OB compared to females, which is consistent with reports among college and university students (Peltzer et al., 2014; Wan Mohamed Radzi et al., 2019). It is generally acceptable for young male adults to be obese and overweight relative to female adults. Asian men may associate strength with being overweight or obese because they view it as a symbol of their masculinity (Jiang et al., 2018). Females are less exposed to pressure

and sparingly develop a pronounced muscular physique compared to males (Izydorczyk et al., 2020). Rather, females treasure a small frame, thereby motivating them to regulate their diet to attain their targeted body shape and size. Regarding age groupings, the higher the BMI of males, the older the age groups.

In this study, BMI and the prevalence of OW/OB were significantly higher among bachelor's degree students. These findings are similar to the results obtained in previous studies (Peltzer et al., 2014; Tapera et al., 2017). Irrespective of gender, based on WHO's classification, bachelor's degree students demonstrated significantly higher prevalence of obesity and overweight relative to associate degree students. Meanwhile, using the Asian cut-off criteria, no significant difference was detected for males by study level, despite the higher prevalence of obesity and overweight among female degree students. Obtaining a bachelor's degree is considered more stressful, which may explain the higher likelihood to weight gain. Moreover, Amr et al. (2019) relayed that stress contributes significant to weight gain among university students (Amr et al., 2019) given that stress shares a positive relationship with weight gain (Haidar et al., 2018).

Since it was not feasible to gather data via face-to-face methods during the pandemic, a self-administered and web-based survey was employed in this study. As a result, one of the obvious disadvantages was the difficulty in contacting people who had limited internet access. Additionally, since two public universities in the study location were the only source of the samples, the findings from this study may not be generalizable to all Malaysian universities. However, given the same features as Malaysian university students, these students may have a similar experience as other university students in Malaysia.

The quality of the respondents' answers could not be ascertained in this study; thus, the potential for response bias cannot be ruled out. Notwithstanding, the usage of online survey platforms during the pandemic may have enhanced the accuracy of the participants' responses. Another weakness of the study was the omission of information regarding each student's ethnic group. Hence, this study could not detect any ethnic variations in the prevalence of obesity and overweight.

5.1.1 Conclusion

The first objective of the study is achieved. During the COVID-19 pandemic, this study is the first attempt to investigate the prevalence of obesity and overweight among higher institution students in Sarawak, Malaysia. Resultantly, students from two public universities in the study area demonstrated a high prevalence of both outcomes – a phenomenon that was observed among one-fourth of the respondents, particularly male and older students. Higher BMI scores were reflected in bachelor's degree students relative to those with associate degrees, with a significant variation in the prevalence between females and males.

The present research marks the first step towards undertaking a more accessible and effective intervention in addressing obesity among college students. These findings suggest the effectiveness of using the Asian cut-off criteria and classification in defining overweight and obesity among Malaysia's university students. In contrast, the proportion of obesity and overweight seems lower when the WHO classification is used, thereby underestimating the true prevalence of both outcomes in the studied population.

5.2 The Effectiveness of ACT and ACT-EX on WRF

Hypothesis 1: There is a significant difference in WRF between ACT, ACT-EX, and CG across the three time points (baseline, post-intervention (week 6) and follow-up (week 12)).

In measuring the effectiveness of ACT and ACT-EX in WRF, the results revealed significant findings. Between ACT and ACT-EX, there was a substantial difference in the interventions' impact on WRF. Both groups reduced the mean score in post-intervention and follow-up, but ACT-EX revealed a large effect size, while ACT has a small effect size (see Table 4.10). These reductions in AAQW scores indicate the effectiveness of ACT approaches in improving WRF, especially with the inclusion of the structured exercise. The results suggest that ACT combined with structured exercise enabled overweight and obese university students to reduce their weight-related difficulties greater than ACT alone. The evidence-based for the ACT as an effective treatment for weight-related difficulties has been well-established (Petersen et al., 2021; Potts, 2018). However, this study is the first one that includes a structured exercise program in an ACT intervention. Sani et al. (2016) reported that body image and self-esteem are pleasant effects that are enhanced by exercise (Sani et al., 2016), thereby contributing to the capacity of ACT in lowering experiential avoidance connected to weight. This indicates that successful interventions to reduce weight-related psychological difficulties (ie., improved WRF) for overweight and obese university students were with ACT and the element of exercise.

In the follow-up, ACT-EX also revealed slightly greater improvement in WRF than the ACT. The lower the score, the more flexible they are in weight-related psychological flexibility. The AAQW-R18 scores was further decreased even though the interventions have ended in the ACT-EX, indicating that the participants were more likely to practice what they had learned during the intervention. They may have continued the exercise by themselves with the ACT

knowledge they obtained, thus making them more psychologically flexible. The exercise intervention may become a habit among the participants in the ACT-EX group, where they underwent three sessions of moderate-intensity exercise for six weeks. Consistently exercising may facilitate more frequent exercise via habit formation (Hagger, 2019), improving the participants' WRF.

For the ACT, participants were able to sustain psychological flexibility after the intervention. This suggests promise that sustaining and maintaining the AAQW-R18 scores is likely after gaining knowledge of and practicing with the ACT. This finding is consistent with previous studies that have found behavioral changes in the long term after ACT model-based interventions (Zhang et al., 2017). In the ACT intervention, the focus is on teaching participants to be mindful and observe their body weight without necessarily feeling bad or denying the number on the scale. The content comprises decisions regarding the nature of body weight (good or bad). Thus, aligning with the ACT concept, it is pertinent to emphasize the interaction between the individual and their thoughts rather than their frequencies and forms. This may instil self-esteem and self-compassion, as the ACT element taught nonjudgmental acceptance of one's body weight to improve WRF. Body image is also another psychological marker that benefits or is nurtured in these interventions. These aspects have proven effective in this study among the participants, with significant changes in the AAQW-R18 scores over time in both groups.

5.3 The Effectiveness of ACT and ACT-EX on BMI changes

Hypothesis 2: There is a significant difference in BMI between ACT, and ACT-EX, across the three time points (baseline, post-intervention (week 6) and follow-up (week 12)).

ACT and ACT-EX had a significant effect on BMI in the post-intervention period, with interventions having a small effect size. Nevertheless, the reduction was greater in ACT-EX at the follow-up. The treatment effect decreased in ACT at the follow-up (see Table 4.15). This is evident in the mean plot for the three groups in three periods (see Figure 4.3). No significant difference was detected between ACT-EX and ACT, despite the fact that the effects of the intervention on BMI differed significantly between the three groups (see Table 4.13). This suggests that both the ACT and the ACT with structured exercise were equally effective in reducing BMI. When comparing the BMI at the follow-up, the BMI was significantly reduced in the ACT-EX than the ACT. The ACT remains steady from post-intervention to follow-up.

It is well established that exercise intervention would promote weight loss and improve BMI (Bellicha et al., 2021; Cox, 2017) as in this study. The follow-up reduction in ACT-EX shows that exercise does affect the sustainability of weight loss. The ACT-EX showed a 7.73% reduction in BMI from baseline to follow-up, while the ACT showed a 4.41% reduction. When the program ended, the weight loss program aimed to ensure the participants kept improving their BMI even with a small, gradual reduction. It is always a challenge to see participants keep attaining their weight loss after a program ends (Hall & Kahan, 2018), which would be likely to be achieved in this present study. Despite the fact that the follow-up was at week 12, which is equivalent to three months, the gradual decrease in BMI is worth mentioning as being sustainable. This finding may suggest that the participants have the potential to continue *to* lose weight over time. Therefore, the structured exercise integrated with ACT benefits BMI

improvement among the overweight or obese participants and could benefit them in the long run.

In a weight management context, ACT posits the alignment of innate personal values and commitment with healthy behaviors. The interplay of these mechanisms function in addressing challenging events and motivation to persist in healthy behaviors (Forman & Butryn, 2015; Lillis & Kendra, 2014). The introduction of structured exercises in the ACT intervention (ACT-EX) assists weight management. In the present study, participants in ACT-EX would likely continue their regular exercise after regularly engaging in three sessions per week for a six-week intervention. The ACT was held once a week for the six-week intervention. The exercise might become a healthy habit and continue after the intervention ends. Through ACT, the participants learned how to identify their values and develop goals that align with those values. This can include goals related to healthy eating and regular exercise. By aligning their actions with their values, individuals may be more likely to stick to healthy habits over the long term. Consequently, weight loss was assisted with the maintenance of physical exercise. ACT intervention has appeared to promote short-term increases in physical activity (Butryn et al., 2011; Wang et al., 2020) and was plausible in this study too.

The ACT intervention effectively conveyed the acceptance element to increase willingness to experience aversive internal states, the distress associated with physical activity. Physical discomfort, fatigue, and other negative emotions that appear during exercise were lessened by practicing the breathing exercise. This was to help the participants increase their tolerance towards the discomfort during the exercise. By increasing the tolerance, the dropout toward physical exercise is lessening. One of the reasons for failure to engage in physical activity among higher institution students is fatigue experienced from workout sessions (Sáez et al., 2021). The present study has proven that there were zero dropouts in the six-week

structured exercise intervention, again showing that they had increased their psychological flexibility.

Therefore, the present study found accord with existing studies that supported the outcome of ACT intervention on weight loss (Katterman et al., 2014; Lillis et al., 2009; Palmeira et al., 2017). By promoting psychological flexibility, ACT intervention can help individuals develop a more balanced and healthy relationship with food and their bodies. This can lead to sustainable weight loss and improved overall health. Improved body weight is likely to result in enhanced acceptance and self-compassion, which can help individuals develop a more positive body image and increased self-esteem.

5.4 The Effectiveness of ACT and ACT-EX on Eating Behavior Changes

Hypothesis 3: There is a significant difference in the mean score of eating behavior (CR, UE, and EE) between ACT, ACT-EX, and CG across the three time points (baseline, post-intervention (week 6) and follow-up (week 12)).

In the measures of eating behavior of TFEQ-18 between ACT and ACT-EX, the results revealed similar improvements in CR and EE, but not in UE. The treatment effect was very small in both groups, ACT and ACT-EX, post-intervention on CR. However, the reduction in ACT-EX was greater during the follow-up (see Table 4.20). As depicted in Figure 4.4, although there is an insignificant difference in intervention and time effect, both the ACT and ACT-EX groups show a reduction in CR from baseline to post-intervention and follow-up. This suggests that both intervention groups may have slightly impacted the CR of the participants, albeit with a small effect size. The inclusion of structured exercise in ACT appears to promote a decline in CR during follow-up. This reduction in CR, reflecting weight loss achieved through voluntary

food intake restriction, is evidently influenced by the ACT intervention, with promising outcomes observed through the incorporation of a structured exercise program.

The psychological flexibility offered by the ACT intervention could promote less restraint in thinking about food restrictions. CR is closely related to BMI and has been reported to be positively associated with it (Anderson et al., 2016; Blumfield et al., 2018; Lopez-Cepero et al., 2018). Given that all university students involved were OW/OB, the slight association between their decreased CR and body weight after the intervention and follow-up should be noted with concern.

A significant reduction in the UE, the second subscale measured in this study, was observed in the ACT compared to ACT-EX at post-intervention and follow-up (Figure 4.5). The treatment effect was moderate in ACT and small in ACT-EX post-intervention. However, it reduced to a small effect in the follow-up (see Table 4.25). ACT has a greater reduction of UE post-intervention than ACT-EX. The feeling of being out of control and tendency to overeat are observed in the UE (Karlsson et al., 2000), which has effectively reduced in the two intervention groups. Even though the effect of ACT-EX was small in post-intervention and follow-up, the inclusion of exercise in the ACT intervention shows some promise.

In addition, the UE items of the TFEQ-18 assessed both internal experiences, comprising feelings, thoughts, and overeating-related behaviors: temptation and stocking up on food. The decline in UE mean scores detected in the ACT-EX and ACT may have elicited a change by reducing the presence of feelings and thoughts that are responsible for overeating. Nevertheless, the ACT theory posits that the effectiveness of UE is indicated by its capacity to enhance the acceptance of these innately values-driven behaviors and experiences despite their being present, rather than eliminating feelings and thoughts linked to uncontrolled eating

(Hayes et al., 2006). In the ACT intervention, eating behavior was discussed alongside the six core elements. The participants shared their history of experiential avoidance related to weight, which was with physical exercise and diet plans, which were aided by those interventions. During the interventions, the ability to decide eating behavior was covered in the 'Choice Point' metaphor.

For the EE, both groups (ACT and ACT-EX) revealed similar effects at post-intervention and follow-up. The treatment effect was small in both groups, ACT and ACT-EX, post-intervention and continued in follow-up (see Table 4.30). Although the intervention and time effects were not significant, both ACT-EX and ACT demonstrated an obvious reduction in EE, as seen in the mean plot from baseline to post-intervention (Figure 4.6). This result implied that both interventions had the same effect of reducing EE and remained stable in the follow-up.

The EE was reported to be significantly decreased by engaging in vigorous-intensity exercise (Martinez-Avila et al., 2020). These findings denote that the ability to eat in response to various negative emotions or resist emotional cues might be positively influenced by exercise. The impact of training on emotional state and mood may explain this result. Mood and stress can be effectively ameliorated by hormonal alterations occurring during exercise (Pedersen & Saltin, 2015). Thus, promoting better eating behavior in terms of emotional response. Likewise, a previous study found that individuals with low perceptions of their physical fitness had lower self-esteem (Jáuregui-Lobera et al., 2014). Hence, the trend of decreased EE in ACT-EX showed the possible effect of hormonal regulation due to regular exercise, improving eating behavior related to emotional response.

The trend of decreased EE in both intervention groups with small effect sizes within and between-groups was in line with a study using face-to-face and mobile applications for ACT intervention (Järvelä-Reijonen et al., 2018). Avoidance of food or higher food intake are two manifestations of EE (Messerli-Bürgy et al., 2018). The present research revealed an EE-reducing trend among the university students in ACT and ACT-EX groups, indicating a higher risk of food avoidance than overeating.

One of the elements taught in the ACT is mindfulness in eating. Fung et al. (2016) highlighted that mindful eating trains the body by increasing awareness of bodily hunger and satiety cues, thereby training the individual to eat accordingly (Fung et al., 2016). This was practiced by the participants, thus improving their eating behavior (CR, UE, and EE). The sensitivity of the physiological satiety signaling system is influenced by regular physical activity, altering the hedonic response to food stimuli, and adjusting macronutrient food choices and requirements (Beaulieu et al., 2017). Thus, this explains the effectiveness of the combined ACT and structured exercise intervention. Over the course of six weeks, the structured exercise program was done three times a week, so it was considered regular physical activity. In the same vein, the present intervention comprised a general ACT with a minor mindful eating element. The decreasing trend in UE, CR, and EE cannot be explained by any other eating-specific content. This suggests the effectiveness of ACT intervention alone and ACT with structured exercise intervention in improving eating behavior among overweight and obese university students.

These findings are consistent with most studies in this area of research. Several studies have consistently reported the effectiveness of ACT and ACT-behavioral based interventions in addressing eating pattern disorders in overweight populations (Afari et al., 2019; Järvelä-Reijonen et al., 2018; Katterman et al., 2014; Lillis et al., 2009; Lillis et al., 2015; Palmeira et

al., 2017; Tapper et al., 2009). Nonetheless, to date, this study is the first attempt to investigate the impact of a combination of ACT and structured exercise on eating behavior. This study proves that changes in eating behavior presented a positive message based on the effectiveness of the intervention, especially in the gradual decline in follow-up. The findings confirm the beneficial effect of the ACT and combined with structured exercise interventions, on the eating behaviors of university students with obesity or overweight. A stable gain or gradual decline is expected from the ACT core elements learned, and the practice of exercise continues among these participants. Resultantly, the university students felt more confident and empowered in managing their eating and related challenges after the intervention and follow-up. These findings are consistent with the goals of ACT, one of which is to increase self-awareness of food and eating.

5.5 Defense Styles and ACT Interventions

Hypothesis 4: There is a significant difference in the mean score of defense styles (mature, immature and neurotic defense style) between ACT, ACT-EX, and CG across the three time points (baseline, post-intervention (week 6) and follow-up (week 12)).

The first defense style, the mature defense style, revealed a significant improvement over time in all groups with moderate effect sizes. The treatment effect was small in ACT and ACT-EX post-intervention. In addition, the effect was consistent in the follow-up (see Table 4.35). The improvement in mature defense style was similar among the ACT and ACT-EX. Although no difference was observed between ACT and ACT-EX, Figure 4.7 depicts that the mature defense style differed significantly and consistently between both groups from baseline to follow-up. This result implied that both interventions were effective in improving the mature defense style among the participants. The CG participants showed inconsistent changes in the

three periods, proving that the mature defense style remains unchanged if no intervention is given.

The mature defense style was reported to have the lowest score of the immature and neurotic defense styles among these participants. This is acceptable because a higher BMI has been correlated with a lower mature defense style (Arafa et al., 2014). The improvement of the mature defense style in the post-intervention and follow-up for both groups revealed that it could be improved using the interventions. The defense style remains unchangeable over time if there is no intervention (Aouad et al., 2021), and this present study has proven it. The ACT interventions improved defensive avoidance, which may develop the participants' mature defense style over time. Experiential avoidance is the target of these interventions, where the element of improving psychological flexibility is nurtured.

The low mature defense style among individuals with high BMI would predict a high immature defense style. This is evident since the immature defense style revealed a significant group interaction effect in moderate effect size by time (baseline, and post-intervention, and follow-up). The treatment effect was large in both ACT and ACT-EX in post-intervention and small in follow-up (see Table 4.40). Table 4.38 depicts no significant difference between ACT and ACT-EX upon comparing the effect. Meanwhile, there was a steady and significant reduction in immature defense style in both groups, from baseline to follow-up (see Figure 4.8). The reduction in immature defense style is consistent with the improvement of mature defense style among the participants. This supports the effectiveness of ACT interventions among the participants. The CG participants showed inconsistent changes in the three periods, proving that the immature defense style remains unchanged if no intervention is given.

A risk factor for overweight and obesity is immature defense styles as they represent primary defense mechanisms, which include repression, denial, and projection. These maladaptive defense mechanisms are more likely to be used by overweight or obese individuals as protective mechanisms against aggressive drives and negative emotions. These features tend to prevent and project them to external objects, which are thus replaced by overeating (Hill et al., 2015). It is viewed as a way of escaping unpleasant awareness. The acceptance element in this therapy may develop a more mature defense style and promote a more flexible psychological among OW/OB university students.

A high level of neurotic defense style was revealed among these participants, similar to the immature defense style. A significant reduction in the neurotic defense style was detected in all groups after the intervention and follow-up. The effect size of this reduction in neurotic defense style was large. The treatment effect was large in both ACT and ACT-EX in post-intervention and small in follow-up (see Table 4.45). The neurotic defense style declined gradually from baseline to follow-up. The decreased in neurotic defense style was similar between ACT and ACT-EX (Figure 4.9). Nevertheless, the effect differed significantly between the two intervention groups and CG (Table 4.43), reflecting the efficacy of ACT interventions with and without structured exercise.

Obesity and higher scores of neuroticism have been reported to be strongly related in previous research (Gerlach et al., 2015; Sutin & Terracciano, 2016), which suggests a positive relationship between BMI and neuroticism. People who are OW/OB are more likely to have a neurotic personality, as was seen in this study of university students. According to Leary and Hoyle (2009), neuroticism denotes a dispositional trait to experience negative effects, such as anxiety, anger, self-consciousness, emotional instability, irritability, and depression. The neurotic defense style is characterized by avoiding guilt and anxiety. Thus, the presence of the

interventions influenced the neurotic defense style over time. The decline of this defense style indicates a great potential of ACT interventions to reduce guilt and anxiety in OW/OB individuals.

The ACT encourages people to identify their values and take action towards their goals while accepting the challenges that come with them. Exercise programs have also linked to a reduction in anxiety and depression and an increase in self-esteem (Rao et al., 2020). Together, the ACT and structured exercise program can help overweight and obese individuals develop a healthier relationship with their body and self-image. By accepting and acknowledging their emotions and thoughts without judgement, participants may experience a reduction in maladaptive (immature or neurotic) defensive behaviors, such as denial, projection or displacement. As they become more in tune with their thoughts and emotions, they may develop a more positive outlook and begin to make changes towards a healthier lifestyle.

Additionally, the physical benefits of exercise, such as improved cardiovascular health and increase strength, can lead to a boost in self-esteem and can lead to an overall improvement in mature defense style and a reduction in immature or neurotic defense behaviors. Therefore, the ACT and ACT-EX proven to reduced maladaptive defense styles and increase in physical well-being among the overweight and obese university students.

5.6 Practical Implication

A notable risk factor is associated with OW/OB individuals, wherein this study focuses on university students. In addition to previous research, the present study supports the use of ACT as an effective and practical intervention for ameliorating BMI and weight-related psychological challenges (Afari et al., 2019; De Freitas et al., 2017; Lillis et al., 2015; Palmeira,

Cunha, et al., 2017; Sairanen et al., 2017; Schumacher et al., 2019), eating behavior (Järvelä-Reijonen et al., 2018; Palmeira et al., 2017) and defense styles for individuals with OW/OB.

Exploring and examining the changes in defense style is the novelty of this study. Despite the literature supporting the higher odds of using immature and neurotic defense styles among OW/OB individuals, a significant improvement in their mature defense style was observed from baseline to post-intervention and follow-up. Defense styles are stable throughout adulthood, especially the maladaptive ones, the immature and neurotic. However, it is proven to be adaptive in this study. The participants revealed a decrease in immature and neurotic defense styles due to the interventions. Those in CG receiving no intervention reported a stable or consistent defense style throughout the study period, which supports the unchangeability of the defense mechanisms. The psychological flexibility obtained from the ACT interventions (ACT and ACT-EX) would likely contribute to the improvements of these defense styles. Hence, ACT could be considered a promising intervention and effective option to the standard treatment for overweight and obesity. This is practical to the health and fitness professional for the weight management program.

In the exercise program, participants were taught to practice acceptance during exercise sessions. This represents the infusion of an ACT element, which is a novel aspect of this study. The inclusion of acceptance during exercise is a unique feature of our approach. Infusing behavioral intervention with exercise programs among fitness professionals may be an important consideration when training fitness personnel in weight loss programs for OW/OB clients. While the increasing obesity epidemic might not be completely addressed by ACT intervention alone, a core component of a weight management program is structured exercise.

Apart from body weight parameters, vital behavioral measures should equally be considered in a weight management program, such as weight-related psychological flexibility and eating behavior. Understanding and exploring the defense styles of the OW/OB individuals should be monitored in a weight management program too. Additionally, the practice of ACT does not require specific requirements, unlike other kinds of behavioral therapies. Thus, this would encourage more health and fitness professionals to learn ACT and apply it to their clients.

Based on the substantial changes and improvement in the post-intervention and follow-up findings, the possibility of enhancing weight-related health behavior change by accepting one's challenges in terms of weight-related difficulties cannot be ruled out. Examples include evaluating personal values and commitment to personally identified behavioral commitments. In the ACT, the participants are encouraged to improve their commitment to having healthier lives, including behavioral strategies when facing negative thoughts and emotions. Therefore, ACT can have an effective influence on overweight and obese individuals.

Overweight and obese individuals can improve their quality of life and reduce their weight and abdominal fat by engaging in physical activity or exercise (Pippi et al., 2022; Silva et al., 2022). The integration of exercise into the ACT intervention assists in managing body weight of the studied population. There is limited information on the usage of ACT as a therapeutic for obese persons (Forman & Butryn, 2015; Lillis et al., 2009; Lillis & Kendra, 2014). ACT remains an effective treatment for several presenting conditions (Ruiz, 2010) but comparisons between combined ACT and "stand alone" structured exercise has not been attempted in the literature.

The likelihood to seek treatment for weight-related issues may be low among individuals experience weight-related challenges and those who had attempted several weight-

loss programs. This problem stem from the feeling of stigmatisation from previous interventions. The current study presents a feasible ACT and regular exercise sessions that are considered less intensive. Moreover, the intervention is characterized by fewer barriers for persons who would not seek or expect benefits from a weight-related intervention.

The present intervention is designed to enhance new health behavior patterns among individuals by improving the core constructs of psychological flexibility – the ability of a conscious individual to completely contact the present moment with acceptance and mindfulness. In principle, there are three ways in which psychological flexibility can facilitate a lasting change: (1) by being more committed to enhanced maintenance of value-driven behaviors, (b) by boosting a willing, open, and accepting the technique of experiencing psychological events, thereby reducing psychological barriers to behavior change, and (c) improving the awareness of one's external and internal environment via mindfulness processes that facilitate proper alignment between behavioral choices and the contextual situation (Butryn et al., 2011). Therefore, a decreased experiential and emotional avoidance through acceptance and increased behavior changes are expected from this therapy.

More flexibility was garnered by using video conferencing platforms (i.e., Zoom and Google meet), which were the feasible methods of intervention during the pandemic. These approaches were cost-effective and convenient for the health and fitness professionals compared to other approaches that necessitate a face-to-face interaction. The acceptability of intervention via video conferencing may be facilitated by the participants' comfort that they did not need to meet with strangers and share their feelings and thoughts. Due to the COVID-19, in which the physical group meeting was not feasible, the video conference meeting was feasible, making the participants have zero dropouts. This type of meeting channel shows great promise with the increasing trend for virtual exercise programs and virtual group therapy meetings. The

content delivered was comparable to a face-to-face meeting. The only difference was the channel used to meet the participants. The input was delivered successfully with fewer barriers. Thus, fitness professionals and therapists or counselors can benefit from this new approach to having a meeting with their clients. It is noteworthy that the video conference was well-accepted, with a 100% attendance rate of the participants.

5.7 Limitations of the Study

A few weaknesses in this study are worthy of being mentioned. First, a face-to-face self-administered survey should have been used rather than the self-reported online form for all outcome measures. Despite previous studies suggesting acceptable agreement levels between measured weight in adult populations and online self-reported weight (Olfert et al., 2018; Pun et al., 2021; Quick et al., 2015), the fact individuals with limited internet access remains an important drawback in this study. An online self-administered survey was used in this study because the COVID-19 pandemic made it impossible to gather data via a face-to-face approach. Thus, this study is not void of reporting bias, as the accuracy of the participants' responses cannot be assured. Notwithstanding, the accuracy of their responses might have been improved by using online platforms during the pandemic.

The present study evaluated the impacts of ACT and the integration of a structured exercise, which entailed education on eating behavior (i.e., mindful eating); however, education on nutrition was not considered. Therefore, eating behavior was solely assessed using the TFEQ-18 subscales only.

This study is limited in terms of generalizability since the majority of the participants were female. In comparison to the previously studied population, the university students were either overweight or obese but did not have any severe medical illnesses. Given that females are more conscious of their health and more likely to stick to a specific diet and attempt weight

loss than males (Bärebring et al., 2018), they had higher chances of participating in this study than males (Ek, 2013). Therefore, it is shown in this study that females were greater in number even though males have been reported to be significantly more overweight and obese than females.

The study utilized an RCT of three groups (ACT, ACT-EX, and CG), which is known as the gold standard and superior. However, there is a limitation that should be acknowledged in this study. The study did not include the structured exercise-only group as the fourth group in the intervention study. Including this group will give a clearer picture of the effects of the interventions. It is recommended in a future study to challenge the structured exercise only on the changes in BMI, eating behavior, and defense style among OW/OB population.

5.8 Strengths of the Study

Notwithstanding its limitations, this study offers several strengths. This study is unique in diverse ways. First, the ACT intervention and the structured exercise sessions were delivered via video conference. This type of delivery has been widely accepted due to the global pandemic. Most participants found the use of Zoom and Google Meet to be acceptable and technologically feasible in delivering the combined intervention. It saved a lot of time, where no travel is needed to attend ACT exercise sessions, and social distancing was allowed. Even though sometimes some of the participants faced audio and connection issues, they were minor and did not hinder them from attending the following sessions. The participants responded positively to this approach. To some, sharing their thoughts and comments in group therapy may be intimidating. However, by this method, they were allowed to turn off their webcam while still engaging in the ACT sessions, which were very inviting and open to the participants. Anxiety and discomfort were expected at the beginning of the sessions. However, they were able to catch up due to this type of approach.

Secondly, a large sample size representing the overweight and obese university students in Sarawak (N = 622) for the prevalence study and intervention study strengthens the results of this study. This study has successfully updated the present statistics on the prevalence of obesity and overweight among university students. This would be a reference for other researchers to conduct studies on this global issue. A high number of volunteers became participants in the study because of the feasibility of the online survey and interventions, which were conducted through video conference.

Thirdly, all the scales demonstrated high validity and reliability, which reflect the reliability of the measures utilized in this study. The researcher suggests it can be used for the same population with overweight and obesity. The revised AAWQ, AAQW-R18 is a newly revised instrument after going through the convergent validity analysis after utilizing the two subscales of TFEQ-18, EE and UE. The DSQ-40 also revealed a high criterion validity with BMI. Studies in the literature examining the defense styles and body weight are scarce. Hence, the high validity of the DSQ-40 would encourage more studies in this area.

To date, this study represents the first attempt to assess the efficacy of an ACT-based intervention for weight loss among overweight or obese university students in Sarawak, Malaysia. The results might be relevant to researchers intending to develop future weight management programmes and interventions. The integration of structured exercise in the ACT intervention makes the study more novel. Robust findings were obtained in this study, highlighting the effectiveness of ACT-EX, a combination of ACT intervention and a structured exercise. Specifically, the combined intervention augmented BMI enhancement as well as eating behaviors and defense styles. The present finding is pertinent in weight management research given the numerous challenges individuals face in achieving long-term weight loss and the fact that practical solutions are yet to be identified.

5.9 Recommendation and Future Direction

The present study has found the effectiveness of ACT intervention and its integration with structured exercise in reducing BMI and improving eating behaviors and defense styles among OW/OB university students. Some recommendations were made based on the findings gathered. First, it is recommended that psychologists and health professionals include structured exercise in body weight management programs, whether it is in a clinical setting or among the general population. This study found the effectiveness where the ACT intervention works well with including structured exercise.

Secondly, fitness trainers are recommended to include ACT intervention in their weight management or weight loss program. The effectiveness of combining therapeutic protocols in encouraging weight loss have been reported in numerous studies. However, structured exercise is still scarce. With the evidence from this study, it is worthwhile to suggest that integrating behavioral elements, which are the ACT, to achieve the overall weight management program goal will ensure the sustainability of psychological flexibility in terms of weight, eating behavior, and defense styles.

Thirdly, psychologists, health professionals, and fitness trainers should work together to help their clients manage weight and improve eating behaviors. A more mature defense style was displayed among the present study's participants after the interventions. This strengthens the need to collaborate with these three prominent bodies in reducing body weight issues.

5.10 Conclusions

Overall, this study contributes significantly to weight management research. This study supports the ACT and structured exercise in augmenting the BMI and improving eating behaviors and defense style changes. The present findings add to the existing knowledge pool

by supporting the effectiveness of combining ACT interventions and structured exercise in promoting weight loss among overweight or obese individuals. Furthermore, the results reflect positive alterations and adjustments in eating behavior and increased weight-related psychological flexibility with reduced BMI. This has been consistently identified as largely influential on the overweight or obese population's life goals. The findings highlight the significance of the behavioral interventions for individuals who want to lose weight, including support with eating behavior, defense mechanisms, and self-empowerment. Based on the promising results garnered by combining ACT and structured exercise, this intervention module is expected to become a reference and guide in terms of psychological support and therapeutics for OW/OB individuals.

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APPENDICES

1. **Ethical Permission Letter**
2. **Research Advertisement 1**

   Research Advertisement 2
3. **Information Sheet and Consent Form**
4. **Physical Activity Readiness Questionnaire (PAR-Q)**
5. **Certificate of Participation to Acceptance and Commitment Therapy Workshop**
6. **Certification of Attendance to Acceptance and Commitment Therapy Webinar with Prof. Steven C. Hayes**
7. **DSQ-40**
8. **AAWQ-R18**
9. **TFEQ-18**
10. **Journal Publication 1**

Pitil, P. P., & Ghazali, S. R. B. (2021). Psychometric Properties of Acceptance and Action Questionnaire (AAQ) for Weight-Related Difficulties Questionnaire among University Students. *Global Business & Management Research*, *13*(2). – Indexed by ERA

11. Journal Publication 2

Pitil, P. P., & Ghazali, S. R. B. (2021). Psychometric Evaluation of the Defense Styles Questionnaire 40 (DSQ-40) In A Sample of University Students. *Global Business & Management Research,* 13(2). – Indexed by ERA

13. Journal Publication 3

Pitil, P. P., & Ghazali, S. R. (2022). Overweight and obesity: a study among university students in Sarawak, Malaysia. *International Journal of Health Promotion and Education*, 1-13. https://doi.org/10.1080/14635240.2022.2040380 – Indexed by SCOPUS – Q4

14. Journal Publication 4

Pitil, P. P., & Ghazali, S. R. (2022). Acceptance and Commitment Therapy and weight-related difficulties in overweight and obese adults: a systematic review. *Psychological Reports*. https://doi.org/10.1177/00332941221149172. – Indexed by SCOPUS – Q2

15. Journal Publication 5

Pitil, P. P., & Ghazali, S. R. (2023, June). An Open Trial Targeting Weight-Related Psychological Difficulties Among Young Adults with Overweight or Obesity During COVID-19 Lockdown. In *Advancing Sports and Exercise via Innovation: Proceedings of the 9th Asian South Pacific Association of Sport Psychology International Congress (ASPASP) 2022, Kuching, Malaysia* (pp. 41-55). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-19-8159-3_4 - Indexed by SCOPUS – Q4

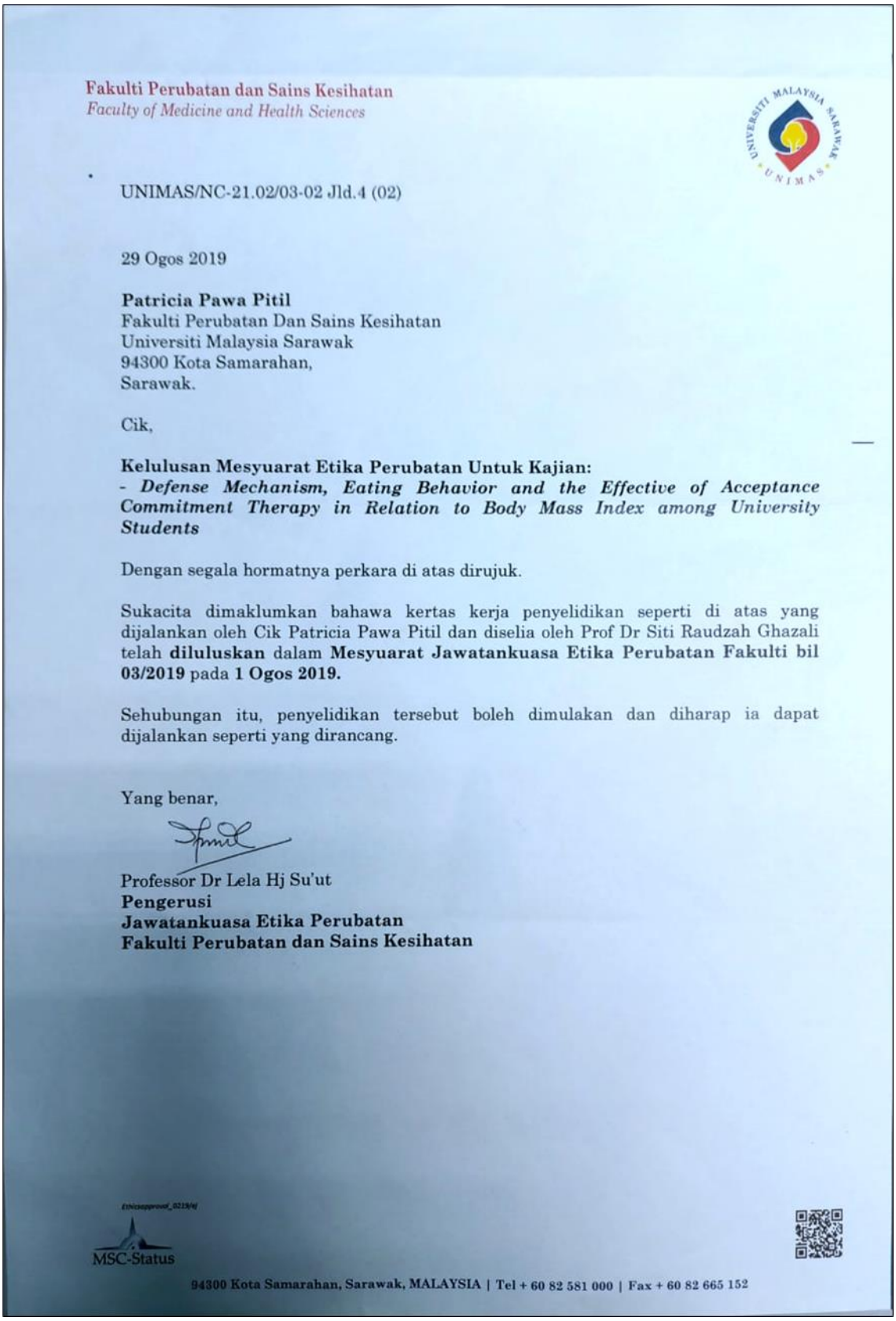
16. Journal Publication 6

Pitil, P. P. & Ghazali, S. R. (2023). The impact of Acceptance and Commitment Therapy (ACT) on the psychological defense mechanism and weight loss program: a randomized controlled trial among university students during COVID-19 movement control order. *Journal of Contextual Behavioral Science,* 29, 171-181, https://doi.org/10.1016/j.jcbs.2023.07.003. – Indexed by SCOPUS/WOS – Q1

17. Proof of Attendance to the Sessions

18. Proof of Fat Loss Coach

Appendix 1: Ethics Permission Letter



Fakulti Perubatan dan Sains Kesihatan
Faculty of Medicine and Health Sciences

UNIMAS/NC-21.02/03-02 Jld.4 (02)

29 Ogos 2019

Patricia Pawa Pitil
Fakulti Perubatan Dan Sains Kesihatan
Universiti Malaysia Sarawak
94300 Kota Samarahan,
Sarawak.

Cik,

Kelulusan Mesyuarat Etika Perubatan Untuk Kajian:
- Defense Mechanism, Eating Behavior and the Effective of Acceptance Commitment Therapy in Relation to Body Mass Index among University Students

Dengan segala hormatnya perkara di atas dirujuk.

Sukacita dimaklumkan bahawa kertas kerja penyelidikan seperti di atas yang dijalankan oleh Cik Patricia Pawa Pitil dan diselia oleh Prof Dr Siti Raudzah Ghazali telah **diluluskan** dalam **Mesyuarat Jawatankuasa Etika Perubatan Fakulti bil 03/2019** pada **1 Ogos 2019.**

Sehubungan itu, penyelidikan tersebut boleh dimulakan dan diharap ia dapat dijalankan seperti yang dirancang.

Yang benar,

Professor Dr Lela Hj Su'ut
Pengerusi
Jawatankuasa Etika Perubatan
Fakulti Perubatan dan Sains Kesihatan

MSC-Status

94300 Kota Samarahan, Sarawak, MALAYSIA | Tel + 60 82 581 000 | Fax + 60 82 665 152

Appendix 2: Research Advertisement





UNIMAS

IT IS FREE OF CHARGE!

ARE YOU STRUGGLING WITH BODY WEIGHT ISSUE?

If yes, you are invited to join a dissertation research study that examines a psychological approach and structured exercise on eating behaviour and body mass index with a specific defence style.

RECRUITING:

University students between the age 18 - 30 years old with body mass index between 23kg/m^2 to 27.4 kg/m^2 (overweight) or 27.5 kg/m^2 to 34.9kg/m^2 (obese) and free from chronic diseases and orthopaedic injuries.

PARTICIPATION INVOLVES:

- 6 sessions (1.5 hour each) of psychology therapy
- 3 sessions (1 hour each) per week of 6-week exercise program
- A follow-up at week 12

Participants' detail will be kept confidential and the sessions will be conducted and monitored by experience fitness trainers and knowledgeable therapist.



If you would like to join the study or to learn more, please contact:

Patricia Pawa Pitil
PhD candidate, Faculty of Medicine & Health Sciences
Email : patriciapitil@yahoo.com
Phone: 013-5633605

Appendix 3: Information of the Study and Consent Forms

INFORMATION OF THE STUDY & CONSENT FORMS

TITLE OF RESEARCH:

DEFENCE MECHANISM, EATING BEHAVIOUR AND THE EFFECTIVENESS OF ACCEPTANCE COMMITMENT THERAPY IN RELATION TO BODY MASS INDEX AMONG UNIVERSITY STUDENTS

INSITUTION:

Universiti Malaysia Sarawak

RESEARCHER:

PATRICIA PAWA PITIL

INSTITUTION ADDRESS:

Faculty of Medicine & Health Sciences, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak

Dear respective participants,

I am Patricia, a PhD candidate for Faculty of Medicine and Health Sciences, UNIMAS. I am doing research on defence mechanism, eating behaviour and the effectiveness of Acceptance Commitment Therapy (ACT) among overweight and obese university students. I would like to invite you to participate in this study. The following information would describe the purpose of my study, your rights as a participant, research procedure, and issues related to confidentiality.

PURPOSE OF THE RESEARCH

Overweight and obesity is a worldwide phenomenon. In Malaysia, it was reported that in 2011 more than 33.6% of the university students were overweight and obese. Highest was among females and the younger students (less than 30 years old). At present, the number has increased to 38.5%. In addition, unhealthy eating and high-calorie food intake during university years among the students could lead to an excess of body weight. The intervention of psychological approach in managing the body weight issue is still infancy. ACT is a cognitive-behavioral approach to target avoidance of individuals when experiencing difficult thoughts and feelings. It is a third-generation cognitive-behavioral approach that uses acceptance and mindfulness processes, and commitment and behavior change processes to produce psychological flexibility; the ability to defuse from difficult

thoughts and accept difficult feelings while persisting in values-based action. This therapy includes six psychological processes: acceptance, defusion, self as context with the present moment, values and committed action. Thus, the ACT will be examined its effectiveness on defence styles, eating behaviour and body mass index among the university students.

TYPE OF INTERVENTION

This research will involve ACT and structured exercise program for a duration of 6 weeks and a follow-up on week 12.

PARTICIPANT SELECTION

I am inviting university students who are overweight (BMI = 23kg/m^2 – 27.4 kg/m^2) or obese (27.5 kg/m^2 – 34.9kg/m^2) to participate in this study.

Your participation in this research is entirely voluntary. You may refuse to take part in the research, or you may withdraw yourself from participation in the research at any time without penalty.

PROCEDURES AND PROTOCOL

Because I do not know if the ACT is better than the structured exercise or the combined ACT and structured exercise for treating overweight/obese, I need to compare the three. To do this, I will put people taking part in this research into three groups. The groups are selected by chance, as if by tossing a coin. The participants will be randomly assigned to one of the three groups. Participants in one group will be joining the ACT sessions while participants in the other group will be involved in the structured exercise tailored for overweight/obese population. The third group will be participating in the combination of ACT and structured exercise program. I will then compare which of the three has the best results.

The research assistants will be looking after you and the other participants very carefully during the study. As stipulated in the University's Policy on Research Integrity, this study has obtained an ethical clearance from the Medical Research Ethics Committee.

If there is anything you are concerned about or that is bothering you about the research please contact;

Researcher:
Patricia Pawa Pitil
PhD candidate
Faculty of Medicine & Health Sciences
Tel: 013-5633605
E-mail: patriciapitil@yahoo.com

Research advisor:
Prof Dr. Siti Raudzah binti Ghazali, Ph.D.
Faculty of Medicine & Health Sciences
Tel: 019-8597933
E-mail: gsraudzah@unimas.my

BENEFIT OF THE STUDY

I strongly believe that information obtained from this study will systematically add more knowledge in this field and indirectly benefit the researcher, university and individuals for the advancement of knowledge and practice of health in the future. As the intervention and study on overweight or obesity are increasingly popular, your participation in this study may help you understand the effect of psychological approach on unhealthy behavior and body weight management. I would like to ensure you that your withdrawal will not cause you losing any benefits or privilege inside or outside the university.

ISSUE OF CONFIDENTIALITY

Although data from the results of this study will be published in a medical journal and will be discussed in the seminar, all information and studies data you provide are confidential. This means your name will not be displayed in the review data. The data collected will be kept up to 5 years and only the researcher and the faculty will have access to these data. If the above explanation is still unclear and you wish to ask any question, please do not hesitate to contact me, my research assistant or my supervisor.

By signing this consent form, you will authorize the review of records, analysis and use of the data arising from this study.

Researcher's name: Patricia Pawa Pitil Participant's name:

Signature: Signature:

WRITTEN PERMISSION FORM TO PARTICIPATE IN THE STUDY

Title of Research:

"Defence Mechanism, Eating Behaviour and the Effectiveness of Acceptance Commitment Therapy in relation with Body Mass Index among University Students

I, _____ have read and understood the information about the research, as provided in the Information Sheet. A clear explanation was already given by PATRICIA PAWA PITIL (researcher) on the study that I would have joined.

I have also given the opportunity to ask questions about this research as well as about my involvement in this research. All questions that I submit have been given explanation and satisfactory answer.

I have read, or have read to me all the pages of the participant's information form. All risks while participating in the research were also given clarification. With this, I voluntarily agree to be a participant and give full cooperation to the team of researchers.

I also understand that I will receive a copy of the form I have signed this for the reference. I know that I am entitled to withdraw from this study at any time, if I want to do so.

My personal information will not be disclosed and the research data will remain confidential. I agree that I will not use any restrictions on the use of any data obtained in this study for academic writing purposes only

Participant's name: IC No:

Signature: Date:

Researcher's name: Patricia Pawa Pitil IC No: 861221-52-5316

Signature: Tarikh:

Appendix 4: Physical Activity Readiness Questionnaire (PAR-Q)

SOAL-SELIDIK KESEDIAAN AKTIVITI FIZIKAL
PHYSICAL ACTIVITY READINESS QUESTIONNAIRE (PAR-Q)

Sila baca soalan di bawah dengan teliti dan jawab dengan jujur: YA atau TIDAK
Read the question below carefully and answer honestly: YES or NO

	Ya *Yes*	**Tidak** *No*
1. **Pernahkah doktor mengatakan bahawa anda mempunyai masalahjantung dan hanya boleh melakukan aktiviti atas saranan doktor?** *Have your doctor said that you have heart problems and can only do exercises recommended by your doctor?*		
2. **Adakah anda berasa sakit di bahagian dada apabila melakukan aktiviti fizikal?** *Do you feel pain in the chest area when doing any physical activity?*		
3. Dalam tempoh sebulan yang lalu, pernahkah anda mengalami sakit dada ketika tidak melakukan sebarang aktiviti fizikal? *Since last month, did you have any pain in the chest area even when not doing any physical activity?*		
4. Adakah anda hilang keseimbangan disebabkan pening atau pernahkah anda pengsan? *Have you ever fainted before?*		
5. Adakah anda mempunyai masalah tulang atau sendi yang boleh menjadi lebih kritikal dengan perubahan aktiviti fizikal anda? *Do you have any bone or joint injuries which can become more severe when you change your exercise routine?*		
6. Adakah doctor anda sedang mempreskripsi sebarang jenis dadah (contohnya, pil air) untuk tekanan darah atau keadaan jantung anda? *Is your doctor advises you to take drugs for high blood pressure and heart failure?*		
7. Adakah anda mempunyai lain-lain sebab untuk tidak melakukan aktiviti fizikal? *Do you know any reason that causes you unable to play sports?*		

- **Sekiranya anda menjawab Ya untuk satu lebih soalan, dapatkan nasihat dari doktor sebelum menjalani kajian ini.**
  If you answer Yes on one or all the questions, seek advice from your doctor before proceeding into this study.
- **Sekiranya anda menjawab Tidak bagi semua soalan, anda boleh terus menjalani kajian ini.**
  If you answer No to all questions, you may proceed with the study.
- **Sekiranya anda berasa kurang sihat, sila tangguh sehingga anda sembuh sebelum meneruskan dengan kajian ini.**
  If you are feeling not well today, please hold until you recover before proceed with this study.

Appendix 5: Certificate of Participation to Acceptance and Commitment Therapy Workshop



NO. SIRI: HM/UL/SJL/PY-003685/2019

JABATAN KESIHATAN NEGERI SARAWAK

Sijil Penyertaan

Dengan ini diakui bahawa

PATRICIA PAWA PATIL

telah menghadiri

BENGKEL"INTRODUCTION TO ACCEPTANCE AND COMMITMENT THERAPY"

pada

19 AUGUST 2019 - 20 AUGUST 2019

di

BILIK AUDIO/MESYUARAT JABATAN PSIKIATRI HOSPITAL MIRI

DR. JACK WONG SIEW YU
Pengarah
Hospital Miri

**Dokumen ini adalah cetakan komputer dan tidak memerlukan tandatangan.*

Appendix 6: Certification of Attendance to Acceptance and Commitment Therapy Webinar with Prof. Steven C. Hayes



Certification of Attendance

THIS IS TO CERTIFY THAT

Patricia Pawa Pitil

has successfully completed a 1.5 hour webinar

A Liberated Mind: Beginning to Put ACT into Practice

with Prof. Steven C. Hayes

on 21st November 2020

RELATE MALAYSIA

DR. CHUA SOOK NING
Founder of Relate Malaysia

Appendix 7: Defense Styles Questionnaire - 40 (DSQ-40)

Defence Styles Questionnaire (Andrew, et al., 1993)

NO	Items	1	2	3	4	5	6	7	8	9	10
		Strongly disagree									Strongly agree
1	I get satisfaction from helping others and if this were taken away from me, I would get depressed.										
2	I'm able to keep a problem out of my mind until I have time to deal with it										
3	I work out my anxiety through doing something constructive and creative like painting or wood work.										
4	I am able to find good reasons for everything I do.										
5	I am able to laugh at myself pretty easily.										
6	People tend to mistreat me.										
7	If someone mugged me and stole my money, I'd rather he be helped than punished.										
8	People say I tend to ignore unpleasant facts as if they didn't exist.										
9	I ignore danger as if I was Superman.										
10	I pride myself on my ability to cut people down to size.										
11	I often act impulsively when something is bothering me.										
12	I get physically ill when things aren't going well for me.										
13	I'm a very inhibited person.										
14	I get more satisfaction from my fantasies than from my real life.										
15	I've special talents that allow me to go through life with no problems.										
16	There are always good reasons when things don't work out for me.										
17	I live more of my life in my dreams than in real life (instead of work more things out in my daydreams than in my real life).										
18	I fear nothing.										
19	Sometimes I think I'm an angel and other times I think I'm a devil.										
20	I get openly aggressive when I feel hurt.										
21	I always feel that someone I know is like a guardian angel.										
22	As far as I'm concerned, people are either good or bad.										
23	If my boss bugged me, I might make a mistake in my work or work more slowly as to get back at him.										
24	There is someone I know who can do anything and who is absolutely just and fair.										
25	I can keep the lid on my feelings if letting them out would interfere with what I'm doing.										
26	I'm usually able to see the funny side of an otherwise painful predicament.										
27	I get a headache when I have to do something I don't like.										
28	I often find myself being very nice to people who by all rights I should be angry at.										
29	I am sure I get a raw deal from life.										
30	When I have to face a difficult situation, I try to imagine what it will be like and plan ways to cope with it.										
31	Doctors never really understand what is wrong with me.										
32	After I fight for my rights, I tend to apologize for my assertiveness.										
33	When I'm depressed or anxious, eating makes me feel better.										
34	I'm often told that I don't show my feelings.										
35	If I can predict that I'm going to be sad ahead of time, I can cope better.										
36	No matter how much I complain, I never get a satisfactory response.										
37	Often I find that I don't feel anything when the situation would seem to warrant strong emotions.										
38	Sticking to the task at hand keeps me from feeling depressed or anxious.										
39	If I were in a crisis, I would seek out another person who had the same problem.										
40	If I have an aggressive though, I feel the need to do something to compensate for it.										

Mature (4): Sublimation (I1, I2), humor (I3,I4), anticipation (I5, I6), and suppression (I7, I8)

Immature (12): Rationalization (I9, I10), projection (I11, I12), denial (I13, I14), omnipotence (I15, I16), making unworthy (I17, I18), transition to action (I19, I20), autistic fantasy (I21, I22), lamination (I23, I24), somatization (I25, I26), passive aggression (I27, I28), displacement (I29, I30), isolation (I31, I32)

Neurotic (4): False altruism (I33, I34), reaction formation (inverse reaction) (I35, I36), idealization (rationalization) (I37, I38), undoing (I39, I40).

Appendix 8: Acceptance & Action Questionnaire for Weight-Related Difficulties – Revised 18 (AAQW-R18)

ACCEPTANCE & ACTION QUESTIONNAIRE FOR WEIGHT-RELATED DIFFICULTIES (AAQW)

NO	Items	1	2	3	4	5	6	7
		Never true						Always True
A1	It's OK to feel fat							
2	When I have negative feelings, I use food to make myself feel better							
3	I try to suppress thoughts and feelings that I don't like about my body or weight by just not thinking them							
4	I am not in control of what I eat							
5	I try hard to avoid feeling bad about my weight or how I look							
6	I am in control of how much physical activity I do							
7	When I evaluate my weight or my appearance negatively, I am able to recognize that this is just a reaction, not an objective fact							
8	In order to eat well and do physical activity, I need to feel like it							
9	I need to feel better about how I look in order to live the life I want to							
10	Other people make it hard for me to accept myself							
		1	2	3	4	5	6	7
		Not at all believable						Completely believable
11	If I'm overweight, I can't live the life I want to							
12	If I feel unattractive, there is no point in trying to be intimate							
13	If I gain weight, that means I have failed							
14	I'm in control of my eating behavior							
15	I don't have what it takes to be healthy for life							
16	My eating urges control me							
17	I need to get rid of my urges to eat better							
18	I am a stable person							
19	I f I eat something bad, the whole day is a waste							
20	I should be ashamed of my body							
21	I need to avoid social situations where people might judge me							
22	I will always be overweight							

***Item 1, 6, 7, 14 and 18 are reversed keyed.**

***Score = 22 (minimum) to 154 (maximum)**

- Lower score indicate less experience avoidance and more psychological flexibility

Appendix 9: Three-Factor Eating Questionnaire-Revised-18 (TFEQ-18)

The Three-Factor Eating Questionnaire-Revised-18 (TFEQ-18)

No	Item	Definitely false	Mostly false	Mostly true	Definitely true
1	When I smell a delicious food, I find it very difficult to keep from eating, even if I have just finished a meal	Definitely false	Mostly false	Mostly true	Definitely true
2	I deliberately take small helpings as means of controlling my weight	Definitely false	Mostly false	Mostly true	Definitely true
3	When I feel anxious, I find myself eating	Definitely false	Mostly false	Mostly true	Definitely true
4	Sometimes when I start eating, I just can't seem to stop	Definitely false	Mostly false	Mostly true	Definitely true
5	Being with someone who is eating often makes me hungry enough to eat also	Definitely false	Mostly false	Mostly true	Definitely true
6	When I feel blue, I often overeat	Definitely false	Mostly false	Mostly true	Definitely true
7	When I see a real delicacy, I often get so hungry that I have to eat right away	Definitely false	Mostly false	Mostly true	Definitely true
8	I get so hungry that my stomach often seems like a bottomless pit	Definitely false	Mostly false	Mostly true	Definitely true
9	I am always hungry, so it is hard for me to stop eating before I finish the food on my plate	Definitely false	Mostly false	Mostly true	Definitely true
10	When I feel lonely, I console myself by eating	Definitely false	Mostly false	Mostly true	Definitely true
11	I conscious hold back at meals in order not to gain weight	Definitely false	Mostly false	Mostly true	Definitely true
12	I do not eat some foods because they make me fat	Definitely false	Mostly false	Mostly true	Definitely true
13	I am always hungry enough to eat at any time	Definitely false	Mostly false	Mostly true	Definitely true
14	How often do you feel hungry?	Only at meal times	Sometimes between meals	Often between meals	Almost always
15	How frequently do you avoid 'stocking up' on tempting foods?	Almost never	Seldom	Moderately likely	Almost always
16	How likely are you to consciously eat less than you want?	Unlikely	Slightly likely	Moderately likely	Very likely
17	Do you go on eating binges though you are not hungry?	Never	Rarely	Sometimes	At least once a week
18	On a scale of 1 to 8, where 1 means no restraint and 8 means total restraint, what number would you give yourself?	1 2	3 4	5 6	7 8

Appendix 10: Publication 1

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Psychometric Properties of Acceptance and Action Questionnaire (AAQ) for Weight-Related Difficulties Questionnaire among University Students

Patricia Pawa Pitil* and Siti Raudzah Binti Ghazali

[1,2]*Department of Psychological Medicine, Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak, Malaysia*
Email: 18010081@siswa.unimas.my, Contact no: 013-5633605

** Corresponding Author*

Abstract
This study evaluates the 22-item of Acceptance and Action on Weight-Related Difficulties Questionnaire-Revised 18 (AAQW-R18), which assesses weight-related psychological flexibility in university students. A total of 120 university students from the Faculty of Sports Science and Recreation, UiTM, aged 18 – 24 years old with a mean BMI= 22.71 ± 4.44 kg/m^2 (range 15.72 – 46.7kg/m^2) participated in this study. Participants were 65% male and 35% female. The corrected item-total correlation found that four items (items 1, 7, 14 and 18) had to be omitted due to low and negative correlations. High internal consistency was found in full length and the new AAQW (AAQW-R18). The new AAQW showed with a good convergent validity property. A two-week test-retest reliability was excellent. Age, gender and BMI categories were similar in AAQW score distributions. The AAQW-R18 demonstrates a greater criterion-related and convergent validity, confirming the validity and reliability of this instrument to measure psychological flexibility assessment among university students. It is concluded that the AAQW-R18 can be used for measuring weight-related psychological flexibility among our population.

Keywords: eating behaviors; experiential avoidance; validity; reliability; weight-related psychology

Introduction
The prevalence of obesity is well documented throughout the world and has been reported to increase steadily (Finucane, Stevens, & Cowan, 2011; James, 2008). Studies have rigorously explored the therapeutic effect of the Acceptance and Commitment Therapy (ACT) on eating behaviors issue (Weineland, Hayes, & Dahl, 2012) and also weight loss (Forman et al., 2013; Forman et al., 2016; Godfrey et al., 2019; Lillis & Hayes, 2007; Sairanen et al., 2015). The approach of ACT offers a viable solution to overcome the psychological issue related to experiential avoidance. Experiential avoidance is a psychological defense mechanism when individuals encounter a psychological issue. It has been proven to be a major factor in weight gain rebound and eating behavior issues.
Acceptance and Action on Weight-Related Difficulties Questionnaire-Revised (AAQ), a measure of experiential avoidance was developed (Hayes et al., 2004) was created, and the updated edition, AAQ-II (Bond et al., 2011). Another tool for assessing weight-related difficulties, feelings and behaviors, Weight-related Difficulties Acceptance and Action

Questionnaire (AAQW) was also developed (Lillis & Hayes, 2007). This inventory has been tested and produces a high internal consistency among the overweight populations.

While ACT weight-related intervention was found to be an effective psychological treatment for weight loss (Forman et al., 2016; Godfrey et al., 2019; Lillis & Hayes, 2007) the Three-Factor Eating Questionnaire-18 (TFEQ-18) subscales were then used as a measurement the effectiveness of this treatment. In this study, it was used as a pair instrument to establish convergent validity for AAQW. The validity and reliability of TFEQ-18 have been previously established (Kavazidou et al., 2012; Löffler A et al., 2015; Martins, da Silva, Maroco, & Campos, 2020).

Although the AAQW appears to have a reliable and robust measure in the overweight population, it is not known if its psychometric properties are sufficient for the general population, especially among university students. University students are young adults who are away from home, live independently to pursue their studies. Most of them struggle with a variety of issues, including eating behavior (Kristanto, Chen, & Thoo, 2016; Pasi et al., 2015) and weight-related issues (Che Wan Jasimah et al., 2019; Tahereh, Rosita, & Hazizi, 2015). Sport science students are eligible to enroll in this course with an athletic background and are physically active in academic years as athletes and to fulfill the academic syllabus demand. Even though the acceptance-based intervention was available in literature among physically active adults (Kangasniemi, Lappalainen, Kankaanpaa, & Tammelin, 2014), the evaluation of AAQW validity and reliability among active individuals is needed.

Conceptually, convergent validity is defined as the proximity of a scale relates to other variables and other measures of the same construct (Krabbe, 2017). In this study, AAQW scores are correlated with TFEQ-18 uncontrol eating and cognitive restraint subscale score. Meanwhile, criterion validity is defined as the degree to which the scores measuring one test criterion are compatible with another test criterion being evaluated (Piedmont, 2014). In this study, AAQW-R18 and BMI are expected to be correlated. Test-retest reliability is defined as a measure of the robustness of the scale, that is, the ability to generate consistent scores over time in a stable population. (Aaronson et al., 2002). In this study, each instrument (AAQW and TFEQ-18) was administered twice in two weeks interval and the total scores of the two instruments would be analyzed to see the correlation.

This study was therefore aimed at determining validity and reliability AAQW instrument among sports science university students. The convergent and criterion validity, internal consistency, and test-retest reliability were tested and evaluated.

Measures

Participants and procedure

A total number of 120 university students participated in this study. They were aged 18 to 24 years old, 65% (n =78) males and 35% (n = 42) female with mean BMI of 22.71 ± 4.44 kg/m^2. Most of the participants were normal weight (47.5%, n = 57) and overweight (37.5%, n = 45). Some were underweight (15%, n =18). They were selected based on their volunteer participation and were recruited among Faculty of Sports Science and Recreation. The AAQW and TFEQ-18 were administered to participants for the evaluation of convergent validity. A test-retest reliability protocol was administered, where they need to complete twice, which the second completion was a 2-week interval after the first test administration. The questionnaires were collected immediately after the participants completed them to ensure they would not remember their answers by checking them. The purpose of this protocol was to ensure consistency and stability of the measurement (Krabbe, 2017).

Acceptance and Action Questionnaire for Weight-Related Difficulties (AAQW)
The AQW is a 22-item assessment (Lillis & Hayes, 2007) with a reverse rating (items 1 , 6, 7, 14 and 18) prior to the total score being calculated (range 22-154) (see Appendix A). A higher score indicates more psychological flexibility in weight-related. The original English version was utilized in this study.

Three-Factor Eating Questionnaire-18 (TFEQ-18)
TFEQ-18 (Karlsson et al., 2000) is a measure to assess eating behavior. The original English version was employed. This inventory has been shown to be both reliable and valid within the general population (Pentikäinen, Arvola, Karhunen, & Pennanen, 2018). This study uses two factors for convergent validity, which are cognitive restraint (item 7 to 15) and uncontrolled eating (items 16 to 18) (see Appendix B). Uncontrolled eating is a desire to overeat as a consequence of a lack of regulated over food and a perceived sense of hunger, while, cognitive restraint represents the urge to limit the intake of food. Cognitive restraint is one of the dietary restraints which comes in two styles: flexible control and rigid control (Westenhoefer, 2001). Furthermore, acceptance-based therapy for weight management could be effective for eating behaviors (Forman et al., 2013). This justifies the selection of these measures as convergent validity. Positive significant correlations were established between the AAQW and cognitive restraint and uncontrolled eating subscales.

Anthropometric measurement
Participants' body weight was gathered using electronic scales. Standing height was measured to the nearest 0.5cm. Body mass index (BMI) was calculated by dividing weight in kg to the height in m squared. The value obtained were then categorized to underweight (< 18.5kg/m^2), normal weight (18.6kg/m^2 – 23kg/m^2) and overweight (> 23.0kg/m^2) (Boo et al., 2010).

Statistical analysis
All analyses were performed using Statistical Package for Social Science (SPSS) version 25. Convergent validity of AAQW and associated measures (uncontrolled eating and cognitive restraint) and test-retest reliability were evaluated using Pearson correlation coefficients where r = .00 to.30 is negligible, > .30 to.50 is low, > .50 to.70 is moderate, > .70 to.90 is high and > .90 to 1.00 is very high (Cohen, Cohen, West, & Aiken, 2003). Cronbach's alpha (α > .80 good fit and > .70 acceptable fit) was used to measure internal reliability (Lance, Butts, & Michels, 2006). Independent sample t-tests were used to examine the demographic variables; age and gender differences in measures AAQW and AAQW-R18. A one-way analysis of variance (ANOVA) was used to assess the total score of AAQW by BMI categories. Statistical significance was set at .05 (p < .05).

RESULTS
Table 1 shows the item characteristics of the 22-item AAQW. Most of the items are skewed to the left (-.808 to -.031) and low kurtosis (-1.136 to -.356). The corrected item-total correlation ranged from -.122 to .548. Items 1, 7, 14 and 18 have low and negative correlations, thus, they are to be considered omitted in further analyses. Internal consistency, Cronbach's alpha, α is .694 and the average inter-item correlation is .091 for the 22-item, however, it increases, α = .760 and the average inter-item correlation is .149 for the 18-item. The alpha if the item is deleted also showed the internal consistency would increases if the four items are eliminated. Thus, these strengthen the exclusion of the four items and retain the 18 items for further analyses.

Regarding the convergent validity, AAQW score is positively and significantly correlated with uncontrol eating (r = .386) and cognitive restraint (r = .214) (p < .05) scores. For criterion-related validity, there is a significant correlation between AAQW-R18 and BMI (r = .189, p < .05). All correlations of the AAQW-R18 are higher with convergent validity measures and criterion-related validity than the full-length of AAQW. For test-retest reliability, the correlation coefficient is r = .933, suggesting a high reliability (Table 2).
Table 3 shows the difference of AAQW by demographic variables. Age, gender and BMI does not significantly different in AAQW (p > .05).

Table 1: Item characteristics of the 22-item AAQW

Item	*M*	*SD*	Sk.	Kurt	$r_{ci\text{-}tc}$	α-id
Item 1	**4.43**	**1.895**	**.247**	**-.927**	**-.046**	**.713**
Item 2	4.22	1.726	-.122	-.865	.207	.689
Item 3	3.92	1.594	-.230	-.815	.158	.693
Item 4	4.21	1.619	-.296	-.639	.144	.694
Item 5	4.00	1.685	-.075	-.748	.237	.686
Item 6	3.38	1.588	-.514	-.426	.110	.697
Item 7	**3.58**	**1.453**	**-.141**	**-.635**	**-.120**	**.713**
Item 8	4.95	1.466	-.808	.576	.033	.702
Item 9	5.16	1.455	-.830	.539	.029	.702
Item 10	4.09	1.852	-.104	-.995	.548	.654
Item 11	3.94	1.898	.025	-1.136	.278	.682
Item 12	4.11	1.389	-.101	-.398	.511	.664
Item 13	3.50	1.715	.061	-.904	.428	.667
Item 14	**3.75**	**1.578**	**-.292**	**-.426**	**-.140**	**.718**
Item 15	3.72	1.588	-.113	-.798	.529	.659
Item 16	3.78	1.486	-.120	-.356	.563	.658
Item 17	4.14	1.457	-.350	-.142	.400	.672
Item 18	**3.25**	**1.361**	**-.795**	**.831**	**-.002**	**.705**
Item 19	3.73	1.674	.104	-.921	.374	.673
Item 20	3.23	1.891	.461	-.953	.553	.651
Item 21	3.82	1.659	-.031	-.504	.429	.668
Item 22	2.56	1.669	.828	-.397	.415	.669
OVRL	86.15	13.20				

AAQW, α = .694; Average inter-item correlation = .091

AAQW-18, α = .760; Average inter-item correlation = .149

Note. Sk. = skewness, Kurt. = kurtosis; $r_{ci\text{-}tc}$ - corrected item-total correlation; α-id = Cronbach's alpha if item deleted; α = Cronbach's alpha

Table 2: Correlation coefficients for AAQW, AAQW-R18 and measures for validation

	AAQW	AAQW-R18
$AAQW_2$	.917*	
$AAQW\text{-}R18_2$		.978*
Uncontrol Eating	.386*	.429*
Cognitive Restraint	.204*	.225*
BMI	.134	.189*

Note. Uncontrolled eating and Cognitive restraint - the constructs in Three-Factor Eating Questionnaire -18 (TFEQ-18)
AAQW-R18 - revised version with omitted items 1, 7, 14 and 18.
$AAQW_2$ - the second measure for AAQW (retest); $AAQW\text{-}R18_2$ = the second measure for AAQW-R18 (retest)
*p < .05

Table 3: Difference of AAQW-R18 by demographic variable

Variable	*M*	*SD*	*F*/*t*	*df*	*p*
Age (years)					
18–20 (*n*=103)	70.03	12.51	-.883	118	.379
21–24 (*n*=17)	73.12	17.92			
Gender					
Male (*n*=78)	69.14	11.55	-1489	118	.139
Female (*n*=42)	72.93	16.05			
BMI (Mean BMI = 22.71 ± 4.44 kg/m^2)					
UW (*n*=18)	68.94	14.60	2.210	117	.114
NW (*n*=57)	68.37	11.80			
OW (*n*=45)	73.73	14.32			

*$p < .05$.
t-value is for age and gender, *F*-value is for BMI.
Score ranges from 18 to 126

Discussion

ACT has become a successful therapy in body weight control and eating behavior, and evaluations to assess the desired targets was confirmed among university students. AAQW was designed to assess weight-related psychological flexibility in the overweight population (Lillis & Hayes, 2007), but it has not been tested in the general population of active individuals. The present study revealed a high internal consistency as reported in previous studies (Palmeira, Cunha, Pinto-Gouveia, Carvalho, & Lillis, 2016; Weineland, Lillis, & Dahl, 2013). With regards to the corrected item-total correlation ranged, item 1 (*It's OK to feel fat*), 7 (*When I evaluate my weight or my appearance negativity, I am able to recognize that this is just a reaction, not an objective fact*), 14 (*I am in control of my eating behavior*) and 18 (*I am a stable person*) have low and negative correlations, thus, they were omitted in further analyses. These items are stated in a positive manner; thus, they may be a certain degree of inconsistency if compare to other items which lead to more problematic eating behavior. As a result, this study finds a briefer, 18-item AAWQ (AAQW-R18) was more accurate and acceptable in university students and our population.

The reduced number of AAQW items attributable to small item-total correlations is representative of the disparity between the general population and the overweight participants in response to these items. The items eliminated are suggestive to be irrelevant to the sports science students in terms of their eating behavior.

The test-retest reliability for the AAQW-R18 found a highly consistent result, $r = .978$, suggesting a stable and reliable measurement. This finding suggests that AAQW-R18 can be used to assess weight-related psychological flexibility among university students. From a functional perspective, the AAQW-R18 is reliable to be used among university students.

AAQW is significantly correlated with all convergent measures; uncontrolled eating and cognitive restraint, however not its criterion-related validity, BMI. Nevertheless, the revised AAQW (AAQW-R18) shows a higher association with those measures and BMI, but in low range. This indicates an adequate convergent and criterion validity of AAQW-R18 in this study. The revised AAQW of this study is comparable with other study (Dochat et al., 2020), were their revised AAQW with 10-item has a low correlation with BMI.

The positive significant correlations between AAQW and AAQW-R18 and uncontrolled eating and cognitive restraint suggest that weight-related psychological flexibility and eating behavior is related but with a distinct construct. These eating behavior measures are subscales from TFEQ-18 which is also reported to be a useful construct in assessing different eating behavior

in a general population (De Lauzon, Romon, Deschamps, Lafay, & Borys, 2004; Kavazidou et al., 2012). Besides, studies have shown that improved psychological flexibility was useful in managing weight and improving eating behaviors (Forman et al., 2013; Forman et al., 2016; Tapper et al., 2009) Therefore, this study proves that weight-related psychology flexibility and eating behavior are a related construct.

As the number of items reduced to 18, the minimum total score is 18 and the maximum score is 126. Therefore, the mean score obtained indicates an acceptable flexible psychology in weight-related difficulties among this population. This is also strengthened by a similar distribution across age groups, gender and BMI categories in the total score of AAQW-R18.

Conclusions

The present study provided encouraging psychometric properties analysis on the AAQW with the omission of four items, to the revised version, the AAQW-R18. The AAQW-R18 tends to be an appropriate indicator of psychological flexibility related to weight for university students. The AAQW-R18 is useful to assess weight-related psychological flexibility in the general population who are likely to be active individuals.

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Appendix A (Weight-related Difficulties Acceptance and Action Questionnaire -AAQW (Lillis & Hayes, 2002))

No	Items
1	It's OK to feel fat
2	When I have negative feelings, I use food to make myself feel better
3	I try to suppress thoughts and feelings that I don't like about my body or weight by just not thinking them
4	I am not in control of what I eat
5	I try hard to avoid feeling bad about my weight or how I look
6	I am in control of how much physical activity I do
7	When I evaluate my weight or my appearance negatively, I am able to recognize that this is just a reaction, not an objective fact
8	In order to eat well and do physical activity, I need to feel like it
9	I need to feel better about how I look in order to live the life I want to
10	Other people make it hard for me to accept myself
11	If I'm overweight, I can't live the life I want to
12	If I feel unattractive, there is no point in trying to be intimate
13	If I gain weight, that means I have failed
14	I'm in control of my eating behavior
15	I don't have what it takes to be healthy for life
16	My eating urges control me
17	I need to get rid of my urges to eat better
18	I am a stable person
19	I f I eat something bad, the whole day is a waste
20	I should be ashamed of my body
21	I need to avoid social situations where people might judge me
22	I will always be overweight

Note. Item 1 to 10 are rated by never true to always true (1 - 7); item 1, 6, 7, 14 and 18 are reversed keyed. Item 11 to 22 are rated by not at all believable to completely believable (1 – 7).

Appendix B (The Three-Factor Eating Questionnaire-Revised-18) (de Lauzon-Guillian et al., 2004)

No	Item
Cognitive Restrained	
1	When I smell a delicious food, I find it very difficult to keep from eating, even if I have just finished a meal
2	I deliberately take small helpings as means of controlling my weight
3	When I feel anxious, I find myself eating
4	Sometimes when I start eating, I just can't seem to stop
5	Being with someone who is eating often makes me hungry enough to eat also
6	When I feel blue, I often overeat
Uncontrolled eating	
7	When I see a real delicacy, I often get so hungry that I have to eat right away
8	I get so hungry that my stomach often seems like a bottomless pit
9	I am always hungry, so it is hard for me to stop eating before I finish the food on my plate
10	When I feel lonely, I console myself by eating
11	I conscious hold back at meals in order not to gain weight
12	I do not eat some foods because they make me fat
13	I am always hungry enough to eat at any time
14	How often do you feel hungry?
15	How frequently do you avoid 'stocking up' on tempting foods?
Emotional Eating	
16	How likely are you to consciously eat less than you want?
17	Do you go on eating binges though you are not hungry?
18	On a scale of 1 to 8, where 1 means no restraint and 8 means total restraint, what number would you give yourself?

Note. Item 1 to 13 are rated by definitely false/mostly false/mostly true/definitely true. Item 14 is rated by almost. Item 15 is rated by almost never/seldom/moderately likely/very likely. Item 16 is rated by unlikely/slightly likely/moderately likely/very likely. Item 17 is rated by never/rarely/sometimes/at least once a week. Item 18 is rated from 1 to 8.

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Appendix 11: Publication 2

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Psychometric Evaluation of the Defense Styles Questionnaire 40 (DSQ-40) In A Sample of University Students

Patricia Pawa Pitil* and Siti Raudzah Binti Ghazali
Department of Psychological Medicine, Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak, Malaysia
Email: 18010081@siswa.unimas.my, Contact no: 013-5633605

** Corresponding Author*

Abstract
The study aimed to evaluate the psychometric properties of the DSQ-40 on a sample of university students. A total of 120 university students from Faculty of Sports Science and Recreation, UiTM, aged 18 – 24 years old with a mean BMI= 22.71 ± 4.44 kg/m^2 participated in this study. Participants were 65% male and 35% female. The internal consistency assessed found an acceptable average inter-item correlation and corrected inter-item correlation. The Cronbach's alpha of the three defense styles and overall DSQ-40 was reported high in both times assessed. Test-retest reliability of a two-week interval proof a stable measurement of the defense styles. Criterion validity was obtained with a significant relationship between mature defense style and BMI. There were significant relationships between defense styles, indicated the existent of the construct validity of the instrument. In differentiating the defenses between age groups, gender, and BMI categories, there was no significant difference ($p > .05$). The present study confirms the applicability of the DSQ-40 in measuring defense styles among non-clinical university students. It is concluded that DSQ-40 can be used for assessing defense styles among university students, a non-clinical population.

Keywords: defense mechanism; defense style; reliability; validity; university students

Introduction
The Defense Style Questionnaire (DSQ) is a self-reported inventory that measures groups of defenses styles based on Vaillant's model of the hierarchy of defense mechanisms derived from psychodynamic theory (Vaillant, 1994). They are ranging from immature to mature defense styles. The defense mechanisms exploration is continuously developed in researches. It's beyond conscious operation that can be revealed in normal functioning or psychopathology condition. Defense mechanisms are characterized as "regulatory processes that allow individuals to reduce cognitive dissonance and to minimize sudden changes in internal and external environments by altering how these events are perceived" (Vaillant, 1993). In coping with tense and anxious circumstances, these mechanisms are in action, unconsciously.
As the assessment of defenses is not reliable, this inventory was developed to quantify the defense styles instead of defense mechanisms separately (Andrews, Singh, & Bond, 1993). They are several versions of the instruments, from the longer version, DSQ-88 to a shorter version and latest, DSQ-40. Vaillant's model was the original measure of defense styles in quantitative (Vaillant, 1971, 1976). An immaturity – maturity continuum was proposed by Vaillant's hierarchical model, thus, the 67-item Defense Style Questionnaire (DSQ-67) was developed (M. Bond, Gardner, Christian, & Sigal, 1983). The possible conscious aspects of defense mechanism assessment were the main objective, with the aim "to elicit manifestations

of a subject's characteristic style of dealing with conflict, either conscious or unconscious, based on the assumption that persons can accurately comment on their behavior from a distance". An 88-item version was then established as a result from the 67-item DSQ (Bond & Vaillant, 1986). In later years, it was modified to a 72-item which consisted of 20 defenses of three factors: Mature, Neurotic and Immature (Andrews, Pollock, & Stewart, 1989), Due to more reasonable psychometric properties, this version was shortened to a 40-item questionnaire with 20 defenses which were more theoretical underpinnings of three factors: Mature, Neurotic, Immature.

The various versions of the defense style questionnaire were established by using the clinical population as the study sample. However, they were utilized in non-clinical population studies to assess the defense style.

Criterion validity is defined as the extent to which the scores measuring one test criterion are compatible with another test criterion being evaluated (Piedmont, 2014). In this study, defense styles and body mass index (BMI) is expected to be correlated. Test-retest reliability was employed, with the aim to assess the robustness of a scale and being able to produce stable scores across time in a population (Aaronson et al., 2002). In this study, the DSQ-40 was administered twice in two weeks interval and the total scores would be analyzed to see the correlation.

Thus, this study aimed to evaluates the psychometric of the 40-item DSQ, which is derived from the original measure (Bond et al., 1983) among the non-clinical university students. The average inter-item correlation, corrected item total correlation, internal consistency, test-retest reliability, criterion validity with BMI measurement were tested and evaluated.

Method

Participants and procedure

Data were obtained from 120 university students. They were selected based on their volunteer participation and were recruited among Faculty of Sports Science and Recreation in a convenience sampling. This sampling technique was chosen due to the availability of the participants, and they represent the university students (Lavrakas, 2008). To participate in this study, each participant gave their informed consent. The questionnaire was completed in meetings gathered with no compensation offered.

The participants were aged 18 to 24 years old, 65% (Lavrakas, 2008) =78) males and 35% (n = 42) female with mean BMI of 22.71 ± 4.44 kg/m^2. However, the data obtained revealed need major attention. Most of the participants were normal weight (47.5%, n = 57) and overweight (37.5%, n = 45). Some were underweight (15%, n =18).

The BMI obtained were evaluated to measure the criterion validity with DSQ-40. Significant relationships were expected between defense style(s) and BMI. The reliability was assessed by administering a test-retest protocol (De Vet, Terwee, Mokkink, & Knol, 2011). This protocol required the administration of the same questionnaire twice over a period of time to the same participants. Reliability is the consistency or reproducibility of measurement (Hopkins, 2000). The participants completed the questionnaire twice with a 2-week interval. A short interval would expect some degree of correlation (Brinkman, 2009). Therefore, this study chose two weeks interval between the administration of the questionnaire to the participants. The questionnaires were collected immediately after completion to prevent the participants to check the first questionnaire when completing the second. It was hypothesized that the items measured from the two different times should correlate highly.

Measures

The original English version DSQ-40 (Andrews et al., 1993) is composed of 40 items which measure the three defense styles categories; mature (anticipation, humor, sublimation and suppression), neurotic (idealization, reaction formation, pseudo-altruism and undoing) and immature (acting out, autistic fantasy, denial, isolation, passive aggression, rationalization, splitting, somatization, displacement, projection, devaluation and dissociation). Each defense style consists of two items. The items statement was responded to on 10-point scales from strongly disagree to strongly agree (1 - 10). Responses to the items were summed and subtracted to the number of items per defense style.

Anthropometric measurement

Participants' body weight was gathered using electronic scales. Standing height was measured to the nearest 0.5cm. The BMI was calculated by dividing weight in kg to the height in m squared. The value obtained were then categorized to underweight (< 18.5kg/m^2), normal weight (18.6kg/m^2 – 23kg/m^2) and overweight (> 23.0kg/m^2) (Boo et al., 2010).

Statistical analysis

Statistical analysis was performed using the Statistical Package for Social Science (SPSS) version 22.0. Internal consistency was examined by using corrected-item total correlation, average inter-item correlation and Cronbach's Alpha, α. The average inter-item correlations should fall between .15 and .50 to meet the reliability measure (Clark & Watson, 1995). An α value greater than 0.6 is desirable reliability (Lance, Butts, & Michels, 2006).

Pearson's correlation was assessed for test-retest reliability and criterion validity of the DSQ-40 and BMI. The correlations between defense styles were also calculated. A significant relationship was set at .05 ($p < .05$). The strength of the underlying relationships was measured where $r = .00$ to.30 is small, > .30 to.50 is low, > .50 to.70 is moderate, > .70 to.90 is high and > .90 to 1.00 is very high (Cohen, Cohen, West, & Aiken, 2003).

Descriptive statistics were presented from the analysis of the Independent sample t-test for age groups and gender differences in measures DSQ-40; mature, immature and neurotic defense style. A one-way analysis of variance (ANOVA) was used to assess the mean scores of the three defense styles by BMI categories. Statistical significance was set at .05 ($p < .05$).

Results

Table 1 shows the item characteristics of the 40-item DSQ-40 and corrected inter-item correlation for the reliability. The skewness (-.827 to .181) and kurtosis (-.885 to 1.416) value were in the normal range, thus the data are in a normal distribution. For the corrected inter-item correlation, the value ranged from .110 to .568, with no negative correlations indicated. The average inter-item correlation was acceptable, .166. All items are retained even there are seven items with less than .3 in the corrected inter-item correlation. The alpha if item is deleted did not affect the Cronbach' alpha much. Thus, the 40-item were eligible for further analyses.

The entire scale of the Cronbach's Alpha coefficient revealed a high internal consistency for both times, $\alpha_1 = .881$, $\alpha_2 = .875$ and for each of the defense styles; $mature_1 = .615$, $mature_2 = .605$, $neurotic_1 = .745$, $neurotic_2 = .721$ and $immature_1 = .834$, $immature_2 = .833$ (Table 2).

The test-retest reliability was high for the three defense styles, $r = .794$ - .991 and overall DSQ-40, $r = .926$ (Table 3).

For criterion validity, mature defense style and BMI shows a significant relationship, $r = .185$, $p < .05$ with small strength but not with immature and neurotic defense styles ($p > .05$). The

construct validity of the scale was proven as the correlations between the defense styles were moderate and significant (r = .259 to .586, p < .05) (Table 4).

Table 1: Item characteristics of the 40-item DSQ

Item	*M*	*SD*	Sk.	Krt.	$r_{ci\text{-}tc}$	α-id
Sublimation 1	6.10	1.835	-.200	.142	.480	.876
Sublimation 2	6.59	1.803	-.829	1.345	.384	.878
Humor 1	5.88	2.091	-.454	-.048	.254	.880
Humor 2	7.18	1.516	-.067	-.454	.296	.879
Anticipation 1	6.92	2.191	-.619	-.262	.375	.878
Anticipation 2	5.98	1.876	-.142	.542	.394	.877
Suppression 1	5.72	2.250	-.112	-.405	.269	.880
Suppression 2	5.50	1.806	-.483	.566	.224	.880
MATURE	6.24	.989	.319	.469		
Rationalization 1	5.61	2.603	-.263	-.885	.117	.884
Rationalization 2	5.63	2.196	-.301	-.050	.435	.877
Projection 1	5.72	2.026	-.450	.496	.452	.876
Projection 2	5.56	2.435	-.019	-.679	.401	.877
Denial 1	5.37	1.490	-.063	1.416	.292	.879
Denial 2	6.20	2.229	-.265	-.487	.362	.878
Omnipotence 1	5.60	2.047	-.293	.037	.452	.876
Omnipotence 2	6.90	2.018	-.809	.732	.201	.881
Mak-unworthy 1	5.60	1.964	-.244	.113	.370	.878
Mak-unworthy 2	4.22	2.265	.181	-.851	.105	.883
Tran-to-act 1	6.47	2.439	-.310	-.346	.473	.876
Tran-to-act 2	6.48	2.470	-.470	-.441	.415	.877
Autistic fantasy 1	6.27	2.110	-.321	.475	.351	.878
Autistic fantasy 2	7.43	1.886	-.153	-.726	.416	.877
Displacement 1	5.98	2.048	-.533	.072	.383	.878
Displacement 2	7.25	1.769	-.091	-.816	.533	.875
Isolation 1	6.92	1.681	.023	-.336	.433	.877
Isolation 2	6.82	1.609	.107	-.005	.506	.876
Pas-agg 1	6.25	2.302	-.265	-.304	.363	.878
Pass-agg 2	6.84	2.050	-.360	-.040	.526	.875
Displacement 1	6.73	1.510	.123	.449	.536	.876
Displacement 2	7.25	1.621	-.185	.084	.459	.877
Somatization 1	5.86	2.412	-.360	-.441	.389	.878
Somatization 2	7.63	1.865	-.620	-.006	.435	.877
IMMATURE	6.29	.937	-.168	2.595		
Fals-altr 1	6.16	2.774	-.385	-.885	.217	.882
Fals-atlr 2	7.52	2.165	-.777	-.066	.341	.878
Reac-form 1	6.62	2.029	-.384	.241	.290	.879
Reac-form 2	6.77	2.057	-.481	.316	.392	.877
Idealization 1	6.32	1.783	.121	-.298	.568	.875
Idealization 2	6.28	2.022	-.209	.039	.567	.874
Undoing 1	6.02	2.323	-.524	-.225	.319	.879
Undoing 2	6.67	1.902	-.344	.471	.445	.877
NEUROTIC	6.61	1.697	3.80	21.96		
Average inter-item correlation DSQ-40 = .166, α = .881						

Note. Sk. = Skewness, Krt. = Kurtosis, *r*ci-tc = corrected item-total correlation, α-id = Cronbach's alpha if item deleted, Mak-unworthy = making unworthy, Tran-to-act = transition to action, Pas-agg = passive aggression, Fals-altr = falsu altruism, Reac-form = reaction formation

Table 2: Cronbach's α for DSQ-40

Defense style	α_1	α_2
Overall DSQ-40	.881	.875
Mature	.615	.605
Neurotic	.745	.721
Immature	.834	.833

Table 3: Test-retest correlations of defense styles and overall DSQ-40 in a two-week interval

Defense style	*r*
Mature	.991*
Neurotic	.794*
Immature	.990*
Overall DSQ-40	.926*

*correlation is significant at .05

Table 4: Correlations between defense styles and BMI

	BMI	Mature	Neurotic	Immature
Mature	.185*	1	.259*	.586*
Neurotic	.145		1	.312*
Immature	.142			1

*correlation is significant at .05

The defense styles mean scores score was divided into three categories of defense styles: mature = 6.239 ± 0.988, neurotic = 6.614 ± 1.698 and immature = 6.286 ± 0.937. The items were rated by using a 10-point scale, where a rate greater than 5 indicates a more agreement to the defense style. Thus, the results show moderate mature, neurotic and immature defense styles. In comparing the scores by age groups, gender, and BMI categories, there are no significant differences in the total score and the three defense styles ($p > .05$). The mean BMI of this study sample is in the normal category (22.71 ± 4.44 kg/m^2) (Table 5).

Table 5: Difference of defense styles mean scores by demographic variable

Variable	Mature	Neurotic	Immature
		M(SD)	
Overall	6.24 (.99)	6.61 (1.70)	6.29 (.94)
Age (years)			
18–20 (*n*=103)	6.27 (.96)	6.57 (1.27)	6.33 (.87)
21–24 (*n*=17)	6.05 (1.14)	6.89 (3.33)	5.99 (1.27)
p-value	.402	.471	.164
Gender			
Male (*n*=78)	6.28 (.94)	6.60 (1.88)	6.27 (.87)
Female (*n*=42)	6.16 (1.09)	6.64 (1.31)	6.31 (1.06)
p-value	.545	.890	.862
BMI, mean BMI = 22.71 ± 4.44 kg/m^2			
UW (*n*=18)	5.99 (.69)	6.49 (1.29)	6.16 (1.10)
NW (*n*=57)	6.24 (1.07)	6.35 (1.35)	6.21 (.99)
OW (*n*=45)	6.34 (.98)	6.99 (2.15)	6.43 (.80)
p-value	.445	.161	.448

Discussion

The present study examines the psychometric properties of the DSQ-40 using a sample of the non-clinical university students by assessing the reliability analysis by using average inter-item correlation, corrected item total correlation and Cronbach's alpha for internal consistency and test-retest reliability and criterion validity with BMI measurement.

The analysis of reliability shows that this questionnaire has adequate internal consistency with positive corrected inter-item correlation and acceptable average inter-item correlation. The Cronbach's alpha yielded by the two-time assessment was also high. In assessing by defense styles, the α value is lower in mature defense styles, even the total DSQ-40 is high, followed by neurotic and immature. A similar finding is also reported in another study including adults, with low reliability for mature (Segal, Coolidge, & Mizuno, 2007).

Test-retest reliability is appropriate in measuring the stability of the DSQ-40 since it examines an individual's defense styles. The response invariability would estimate measurement error (Hays, Anderson, & Revicki, 1993) however, in this study, the responses in two different times are considered stable. This study supports the reliability of this instrument to be used among the non-clinical group which is the university students. This result is consistent with a study using a clinical group as participants and the same reliability design protocol (Yilmaz, Gencoz, & Ak, 2007). In another study that involve university students as participants have also found similar results but with a two-month interval between the administration of the questionnaire (Hayashi, Miyake, & Minakawa, 2004). Defense mechanisms are developed under unconscious and highly associate with ego development and psychopathology (Waqas et al., 2015), measuring them under two intervals would validate the instrument. Although some of the studies suggested an interval of 7 days up to several months to administer the second test, this study chose a two-week interval. Defense mechanisms operate at an unconscious level, therefore the interval would not be affecting the responses to the instrument.

There were significant correlations between the defense styles, thus this indicates that they are not independent. These verified that the defenses are directed along a mature or adaptive defense to immaturity or maladaptive defenses continuum (Andrews et al., 1993). Those who age-matured are more towards mature defenses; sublimation, suppression, anticipation and humor (Segal et al., 2007) and also lower levels of psychopathology; neurotic defenses. The less adaptive defense styles are the neurotic defenses while the immature defenses are associated with difficulty controlling, conveying, and recognizing emotional events. This study involved university students aged above 18 years old, thus mature defense revealed a moderate relationship with immature defense and a weak relationship with neurotic defense.

Defence mechanism has been a new topic in body weight issues. Individuals with psychological issues in body weight will employ certain types of defense styles. The criterion validity was found from a significant positive correlation between mature defense style and BMI with small strength. However, immature and neurotic did not significantly correlate with BMI. In contrast with a study conducted among obese participants reported that immature defense style correlated with BMI (Arafa, Hussein, Fahmy, Abd El Mawella, & Nassar, 2014). However, in a study using high school female students revealed that mature defense style; humor and altruism and some immature defense styles; displacement and annulment were correlated significantly with BMI (Alipour, Golshani, & Kouchakentezar, 2016). Therefore, criterion validity is obtained, with a small strength correlation. The higher the BMI of the participants, the greater their mature defense style score. The participants' muscle mass could influence their BMI, where the sample was sports science students who are highly active. Therefore, their BMI is high due to muscularity, thus this explains the more mature defense style even with increased BMI.

Indirect construct validity was measured during the administration of the questionnaire. The feedback of the participants was obtained on the words or terms that they do not understand. The researcher took note of the terms questioned and gave a brief explanation of the meaning of the sentence in which that terms being used. This kind of feedback is very important to ensure that the participants answered the intended construct. From this information, the words or terms will be subjected to modification to alter to the participants' understanding. For

example, Denial 1, *I'm a very inhibited person*, was changed the word *inhibited* to *self-consciousness*. This changes the item to: *I'm a very self-conscious person*. Changing the sentence would give a better idea of the meaning of the construct, thus it would measure the construct precisely.

The mean scores for the three defense styles were relatively moderate. This could be due to the sample was non-clinical. A clinical sample would reveal a more prominent mean score in defense style(s). In addition, the study's finding is inconsistent with previous studies pertaining to differences in defense use by gender (Cazan & Clinciu, 2015; Diehl, Fuchs, Rathmann, & Hilger-Kolb, 2018; Waqas et al., 2015). This study observed that there was a similar distribution of defense style scores between male and female participants. Female students were reported to be more studious, would employ high neurotic (Diehl et al., 2018), tend to not yield greater in any defense style in this study. The participants recruited were sports science students, who are highly active in physical activity and some of them are athletes. Therefore, they have a channel to divert their stress due to academic or life as university students through sports participation. Thus, this influences similar scores of the three defense styles.

Conclusion

The DSQ-40 is reliable and valid to be used among the university students in measuring their defense styles. For assessed criterion validity, there were found acceptable validity. The high correlation of test-retest scores and high internal consistency is the proof of its stability and reliability. Hence, the DSQ-40 is a good measure in assessing the defense styles of university students. Future studies should be carried out which assess similar scales for construct validity and different scales for divergent validity. This study recommends the use of this instrument among university students.

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Appendix A (Defense Style Questionnaire-40, (Andrews et al., 1993)

NO	Items
	I get satisfaction from helping others and if this were taken away from me, I would get depressed.
2	I'm able to keep a problem out of my mind until I have time to deal with it
3	I work out my anxiety through doing something constructive and creative like painting or wood work.
4	I am able to find good reasons for everything I do.
5	I am able to laugh at myself pretty easily.
6	People tend to mistreat me.
7	If someone mugged me and stole my money, I'd rather he be helped than punished.
8	People say I tend to ignore unpleasant facts as if they didn't exist.
9	I ignore danger as if I was Superman.
10	I pride myself on my ability to cut people down to size.
11	I often act impulsively when something is bothering me.
12	I get physically ill when things aren't going well for me.
13	I'm a very self-conscious person.
14	I get more satisfaction from my fantasies than from my real life.
15	I've special talents that allow me to go through life with no problems.
16	There are always good reasons when things don't work out for me.
17	I live more of my life in my dreams than in real life (instead of work more things out in my daydreams than in my real life).
18	I fear nothing.
19	Sometimes I think I'm an angel and other times I think I'm a devil.
20	I get openly aggressive when I feel hurt.
21	I always feel that someone I know is like a guardian angel.
22	As far as I'm concerned, people are either good or bad.
23	If my boss bugged me, I might make a mistake in my work or work more slowly as to get back at him.
24	There is someone I know who can do anything and who is absolutely just and fair.
25	I can keep the lid on my feelings if letting them out would interfere with what I'm doing.
26	I'm usually able to see the funny side of an otherwise painful predicament.
27	I get a headache when I have to do something I don't like.

28 I often find myself being very nice to people who by all rights I should be angry at.
29 I am sure I get a raw deal from life.
30 When I have to face a difficult situation, I try to imagine what it will be like and plan ways to cope with it.
31 Doctors never really understand what is wrong with me.
32 After I fight for my rights, I tend to apologize for my assertiveness.
33 When I'm depressed or anxious, eating makes me feel better.
34 I'm often told that I don't show my feelings.
35 If I can predict that I'm going to be sad ahead of time, I can cope better.
36 No matter how much I complain, I never get a satisfactory response.
37 Often I find that I don't feel anything when the situation would seem to warrant strong emotions.
38 Sticking to the task at hand keeps me from feeling depressed or anxious.
39 If I were in a crisis, I would seek out another person who had the same problem.
40 If I have an aggressive though, I feel the need to do something to compensate for it.

Mature (4): Sublimation (I1, I2), humor (I3, I4), anticipation (I5, I6), and suppression (I7, I8)
Immature (12): Rationalization (I9, I10), projection (I11, I12), denial (I13, I14), omnipotence (I15, I16), making unworthy (I17, I18), transition to action (I19, I20), autistic fantasy (I21, I22), lamination (I23, I24), somatization (I25, I26), passive aggression (I27, I28), displacement (I29, I30), isolation 9I31, I32)
Neurotic (4): False altruism (I33, I34), reaction formation (inverse reaction) (I35, I36), idealization (rationalization) (I37, I38), undoing (I39, I40).
Note. All items are rated by using strongly disagree to strongly agree (1 -10).

View publication stats

Appendix 12: Publication 3

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Overweight and obesity: a study among university students in Sarawak, Malaysia

Patricia Pawa Pitil [a,b] and Siti Raudzah Ghazali [a]

[a]Faculty of Medicine & Health Science, Universiti Malaysia Sarawak, Kota Samarahan, Malaysia; [b]Faculty of Sports Science & Recreation, Universiti Teknologi Mara Sarawak Branch, Kota Samarahan

ABSTRACT

Overweight and obesity are on the rise throughout Asia, with Malaysia at the top of the list. However, the most recent data among young people, particularly university students in Asia, are scarce. This study aimed to report the prevalence of overweight and obesity among university students attending two public universities in Sarawak, Malaysia, based on demographic data that included their levels of study, gender, and age ranges. This is a cross-sectional research approach, which surveyed 622 university students aged from 18 to 24 years enrolled in associate and bachelor's degree study. A self-administered questionnaire was distributed via an online platform from March to November 2020. Body mass index (BMI) was calculated from the obtained self-reported body weight and height for body weight status adhering to the World Health Organisation (WHO) and Asian cutoff scales. Based on the WHO cutoff scale, the prevalence of overweight and obesity was 14.31% and 10.13%, respectively, which is lower than Asian cutoff scale prevalence, 22.19% and 16.88%, respectively. A high prevalence of overweight and obesity was noted among the study sample, particularly male students. Bachelor's degree students recorded higher BMI than those at associate level. Age groups were prominent in the prevalence of overweight and obesity in males, but an exception in females. In conclusion, a high prevalence of overweight and obesity was observed in this study. This study provides valuable data that may be applied to devise strategic interventions at improving the health of university students.

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KEYWORDS
Malaysians; overweight; obesity; prevalence; university students

Introduction

Obesity is one of the most significant causes of death worldwide, with escalating prevalence of overweight and obesity among adults across developing and developed countries. Health concerns about body weight and risks related to obesity have increased. The worldwide prevalence of obesity has risen by three-fold since year 1975. Notably, 650 million adults aged 18 years and above (13% of adult population worldwide) were reported to be obese. Nonetheless, gender variance was noted in obesity prevalence, whereby more females (15%) were obese than males (11%) (WHO 2017).

CONTACT Patricia Pawa Pitil patriciapawa@uitm.edu.my Faculty of Sports Science & Recreation, Universiti Teknologi Mara Sarawak Branch, 94300 Kota Samarahan, Sarawak

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Based on the statistics recorded in Malaysia, half of the adults were overweight and obese. The National Health and Morbidity Survey (NHMS) reported the increasing trends of overweight and obesity among adults when compared to findings reported in NHMS 2011 (29.4%, 15.1%) (IPH 2011) and NHMS 2015 (30.0%, 17.7%) (IPH 2015). Moreover, NHMS 2019 recorded increment of overweight and obese adults to 30.4% and 19.7%, respectively (IPH. 2019. National Health and Morbidity Survey (NHMS) 2019).

Obesity is defined as the disproportion of body mass to body height. For the general population, overweight is indicated by body weight to height index; ranging at 25–29.99 kg/m^2, while obesity is over 30.0 kg/m^2 (WHO 2017). Higher scores signify the more serious health issue of being extremely obese. Overweight or obesity is defined as the excess storage of fat in the body that causes health problems and, subsequently, excess morbidity and mortality (Brown et al. 2009). Meanwhile, the Asian cutoff points that indicate overweight and obesity are slightly different. Overweight ranges at 23.0–27.49 kg/m^2 and obese is above 27.5 kg/m^2 (Zainudin et al. 2011).

University students refer to individuals who are at the beginning of their adulthood phase. It is the transition where they become independent and away from home (Stok et al. 2018). Decision-making skills are learned during university years, as university students are responsible for everything they decide and do. At this phase, most of their activity daily routine is created, from eating habit to physical activity lifestyle. Most university students were reported to eat poor nutrition due to this transition (Lacaille et al. 2011; Gan et al. 2011), stressful academic calendar and poor time management.

Additionally, high physical inactivity and excessive calorie intake due to the Coronavirus Disease 2019 (COVID-19) pandemic restriction movement control order (MCO) in 2020 had forced the students to stay at home at all times and engaged in Force Distance Learning (FDL). Unlike previous days with a broad range of university activities and programs, the university life of this population mostly focuses on completing assignments and attending teleconference lectures. Such mundane activities lead to a sedentary lifestyle. Even before the pandemic outbreak, university students used to sit 8–10 hours attending lectures, spending their leisure time, working and commuting (Cowgill et al. 2021). Young people should perform vigorous activity at least an hour daily to counteract the adverse health effects of sedentary lifestyle, which commonly involves overeating habit (Sallis and Glanz 2009).

With the increasing prevalence of overweight and obesity in Asia, the use of the BMI as a disease predictor has grown in importance. However, a full comparison between the cutoffs employed by the WHO and in Asia has not been undertaken in any prevalence studies conducted in Malaysia. Excess BMI is linked with health risks, including cancer, gynaecological complications, type-2 diabetes, stroke, asthma, coronary artery disease, hypertension, gallbladder and liver diseases, osteoarthritis and sleep apnoea (Poirier et al. 2006), which may affect one's quality of life (Pimenta et al. 2015). Numerous studies have explored issues related to increase in body mass amongst students. Before the pandemic, Peltzer et al. (2014) reported the prevalence of overweight and obesity, as well as its related factors amidst university students from 22 countries. The study reported that 22% of the study population was overweight and obese (19.3% women & 24.7% men). In 2019, a study among Malaysian university found that 21.2% and 16.3% of the samples were overweight and obesity, respectively (Wan Mohamed Radzi et al. 2019). However, during the COVID-19 pandemic, weight increases were reported among Malaysian university students (Tan,

Tan, and Tan 2021a). Due to the new norms, where FDL is enforced, we wanted to explore if the prevalence of body weight status among university students has changed. Only a limited number of studies have explored the prevalence of overweight and obesity among university students during the pandemic outbreak. Hence, this study examined the prevalence of excess BMI, overweight and obesity among university students in two universities in Sarawak based on demographic data that included their levels of study, gender and age ranges, while both the WHO and Asian cutoff points were used.

Methods

Participants

This study involved 622 university students who enrolled in associate and bachelor's degree programs from two public universities in Sarawak, Malaysia, aged from 18 to 24 years old. A convenience sampling method was employed to select the respondents. All the undergraduate students from the two universities were invited to participate in this study. The inclusion criteria for the respondents were that they should be Malaysian and registered as a full-time student, an associate and a bachelor's degree student. The exclusion criteria applied to pre-university students, pre-diploma students and students who had no internet coverage during data collection. The sample size was computed based on the Krejcie and Morgan method (Krejcie and Morgan 1970), assuming a 5% margin of error, a 95% confidence level and 21,584 total students from both universities (UiTM Sarawak had 8,063, while UNIMAS had 13,521 as of 2020). Thus, the minimum sample size required for this study was 377 respondents. A total of 622 respondents answered this survey, of whom 330 and 292 were associate and bachelor's degree students, respectively.

Design and procedure

A cross-sectional descriptive study was executed among university students recruited on a voluntary basis. Data were collected from online platforms between March and November 2020, when restriction movement control order was implemented globally, including in Malaysia. A web-based anonymous self-administrated questionnaire was hosted on Google Forms and circulated around the prospective respondents through social media platforms, including WhatsApp and Facebook. Informed consent was obtained from the respondents before the first survey question was revealed. This study was approved by the Universiti Malaysia Sarawak Research Committee, which was operated following the ICH Good Clinical Practice Guidelines, Malaysia Good Clinical Practice Guidelines and the Declaration of Helsinki (UNIMAS/NC-21.02/03-02 Jld.4 (02)).

Measures

Self-reported body weight and height were obtained from the participants. Self-reported body weight and height measurements taken from young adults may be used to calculate BMI for weight classification purpose (Olfert et al. 2018; Quick et al. 2015; Sherry,

Jefferds, and Grummer-Strawn 2007; Pun, Thangiah, and Majid 2021). Thus, the gathered data were considered reliable for this study analysis. The individual's self-reported weight and height values were recorded to the nearest kilogram (kg) and centimetre, respectively. In this section, to obtain the body weight, instructions were provided on how to self-weigh, with bathroom scales at home to be used whenever possible. The other recorded information included their gender, age (in years) and level of study.

The BMI was determined by dividing body weight (kilograms) with height (meter squared) (kg/m^2). Two references were used in BMI categorisation. The first one was based on the WHO overweight and obesity factsheet (underweight: <18.50 kg/m^2, normal weight: 18.50–24.99 kg/m^2, overweight: 25.0–29.99 kg/m^2, and obese: ≥30.00 kg/m^2) (WHO 2017), while the second one was according to Asian categorisation (underweight: <18.50 kg/m^2, normal weight: 18.50–22.99 kg/m^2, overweight: 23.0–27.49 kg/m^2, and obese: ≥27.50 kg/m^2) (Zainudin et al. 2011).

Statistical analysis

The gathered data were keyed in and analysed using the Statistical Package for Social Science (SPSS) version 26 softwares. Descriptive statistics were computed to assess the demographic variables (see Table 1 and Figure 1). The continuous variables are presented as mean ± standard deviation. Upon comparing the parameters among gender, study levels and BMI groups, independent sample t-test and analysis of variance (ANOVA) test were executed for continuous variables, whereas Pearson chi-squared test was carried out for categorical variables. The effect size for the independent sample t-test was evaluated using Cohen's d, the ANOVA was evaluated using partial eta squared (η^2), and Cramer's V value was used for the Pearson chi-squared test. The magnitude of the effect size was classified as small: 0.20–0.50, medium: 0.50–0.50 or strong: >0.80 for Cohen's d. The η^2 and Cramer's V were evaluated as follows: No or very weak: 0.00–0.04; weak: 0.05–0.09; moderate: 0.10–0.14; strong: 0.15–0.24; very strong: >0.25 (Cohen 2013). The equal variance assumption was satisfied for ANOVA at $p > .05$. Statistical significance was fixed at p-value < .05.

Table 1.. Demographic characteristics of the participants.

Variables	Frequency (N = 622)		Percentage (%)	
Gender				
Male	175		28.13	
Female	447		71.86	
Age (years)				
18–20	354		56.91	
21–23	246		39.55	
≥24	22		3.54	
BMI	WHO	Asian	WHO	Asian
Underweight	116	116	18.65	18.65
Normal weight	354	263	56.91	42.28
Overweight	89	138	14.31	22.19
Obese	63	105	10.13	16.88
Level of study				
Associates	330		53.05	
Bachelor's degree	292		46.95	

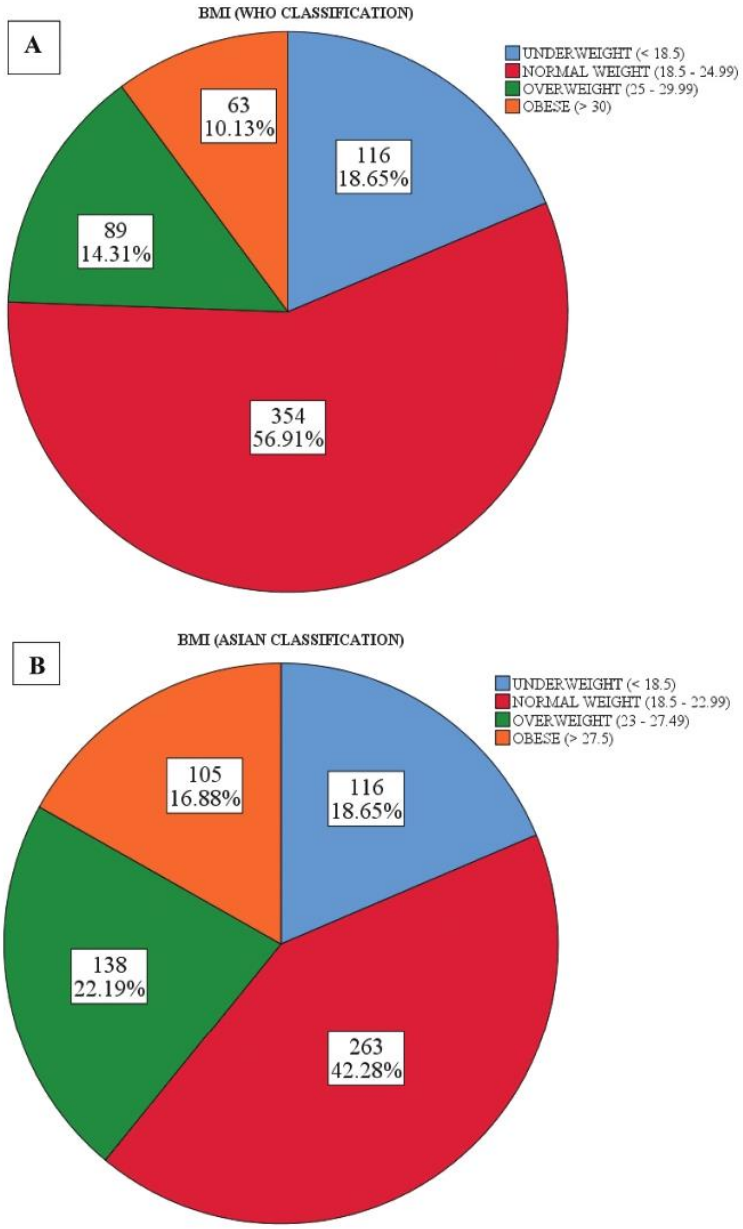


Figure 1. The proportion of students in each BMI group based on (A) WHO classification and (B) Asian classification. Note: The unit for BMI classification is measured in kg/m^2.

Results

Participants' characteristics

In total, data was analysed based on 622 university students' participations. Table 1 lists the demographic details of the participants. The number of male students was 175 (28.13%), while female students were 447 (71.86%). Among the respondents, 354 (56.91%) were 18–20 years old, while 246 (39.55%) were 21–23 years old, and 22 (3.54%) of them were 24 years old and above.

Prevalence of overweight and obesity

Results show that the prevalence of normal, overweight and obese was 56.91%, 14.31% and 10.13%, respectively, for WHO classification, whereas 42.28%, 22.19% and 16.99%, respectively, for Asian classification. The underweight prevalence was 18.65% and 18.65%.

Results also found that the male BMI (24.25 ± 5.88 kg/m^2) was significantly higher than the female students (22.50 ± 4.93 kg/m^2) ($p < .05$), with a very strong effect size, Cohen's $d = 0.32$. In relation to age, one-way ANOVA suggested that the older participants have significantly higher prevalence of the weight and BMI (see Table 2). Significant variances were also found in weight and BMI among the age groups for males ($p < .05$) with weak effect size ($\eta^2 = 0.04–0.09$). Age 24 years and above (Weight, 81.79 ± 26.66 kg; BMI, 28.60 ± 7.12 kg/m^2) recorded the highest mean score in comparison with the other age group (Weight, 18–20 years old = 69.04 ± 18.94 kg, 21–23 years old = 70.89 ± 17.32 kg; BMI, 18–20 years old = 23.31 ± 5.85 kg/m^2, 21–23 years old = 24.77 ± 5.65 kg/m^2). No variable displayed significant difference for females ($p > .05$). However, a significant difference in BMI mean value was found between associates and bachelor's degree levels of study (associates = 22.43 ± 5.23 kg/m^2, bachelor's degree = 23.64 ± 5.24 kg/m^2 ($p < .05$)) with a very weak effect size, $\eta^2 = 0.01$.

Differences in BMI groups between age groups by gender were also analysed (see Table 3) based on WHO and Asian classifications. There were significant differences in BMI groups for the age groups among males ($p < .05$) with a strong effect size (Cramer's V = 0.20). No significant variance was observed among females ($p > .05$). When the Asian cutoffs were applied, both males and females had slightly greater proportion of overweight and obesity cases. However, the proportion of normal weight was slightly lower when compared with WHO classification. Similarly, the proportion of underweight did not display obvious difference in both classifications. Upon comparing study levels, BMI groups significantly differed in both classifications ($p < .05$), with a strong effect size (Cramer's V = 0.14).

Figure 1 illustrates the fraction of every BMI group. Figures 1a and 1b display the proportions of BMI groups according to WHO and Asian cutoffs, respectively.

Discussion

The study outcomes revealed the prevalence of overweight and obesity among university students attending two public universities in Sarawak, Malaysia, based on the WHO and Asian classifications. The prevalence was 14.31% and 10.13%, which were lower than those of Asian cutoff points at 22.19% and 16.88%, respectively. It had been

Table 2. Mean and standard deviation (M ± SD) of height, weight, and BMI of university students by age group.

Gender	Variable			18–20 years old 354 (56.9)	21–23 years old 246 (39.5)	≥ 24 years old 22 (3.5)	*p*-value	η^2
Male								
n = 175 (28.14%)	*n*			80	87	8		
	Height (m)	1.68 ± .07		1.67 ± .07	1.69 ± .06	1.70 ± .08	.274	
	Weight (kg)	69.04 ± 18.94		65.75 ± 19.21	70.89 ± 17.32	81.79 ± 26.66	.031*	0.04
	BMI (kg/m^2)	24.25 ± 5.88$^{\varnothing}$	Cohen's *d* = 0.32	23.31 ± 5.85	24.77 ± 5.65	28.6 ± 7.12	.046*	0.23
Female								
n = 447 (71.86%)	*n*			274	159	14		
	Height (m)	1.56 ± .06		1.56 ± .06	1.57 ± .064	1.55 ± .05	.515	
	Weight (kg)	55.16 ± 13.57		54.21 ± 13.44	56.87 ± 13.87	54.36 ± 11.67	.140	0.09
	BMI (kg/m^2)	22.50 ± 4.93$^{\varnothing}$		22.16 ± 4.85	23.08 ± 5.06	22.54 ± 4.49	.169	0.08
Study level								
Associates *n* = 330 (53.05%)	BMI (kg/m^2)	22.43 ± 5.23	*p*-value = .004*	η^2 = 0.01				
Bachelor's degree *n* = 292 (46.95%)		23.64 ± 5.24						

Abbreviations: BMI, body mass index; η^2, eta squared
*$p < .05$, $^{\varnothing}p < .05$ for BMI between gender.
Note. equal variance assumption was satisfied in all compared variables ($p > .05$).

Table 3. Prevalence of BMI among university students by age groups and study levels.

		International classification (WHO)						Asian classification					
Variables		UW (<18.50kg/m^2) *n* = 116 (18.65%)	NW (18.50 – 24.99 kg/m^2) *n* = 354 (56.91%)	OW (25.0 – 29.99 kg/m^2) *n* = 89 (14.31%)	OB (≥ 30 kg/m^2) *n* = 63 (10.13%)	*p-value*	CV	UW (<18.50kg/m^2) *n* = 116 (18.65%)	NW (18.50 – 22.99 kg/m^2) *n* = 263 (42.28%)	OW (23.0 – 27.49 kg/m^2) *n* = 138 (22.19%)	OB (≥ 27.5 kg/m^2) *n* = 105 (16.88%)	*p-value*	CV
Gender	Male	25 (14.28)	92 (52.57)	28 (16.0)	30 (17.14)	.001*	.16	25 (14.28)	65 (37.14)	40 (22.86)	45 (25.71)	.002*	.16
	Female	91 (20.44)	262 (58.61)	61 (13.65)	33 (7.38)			91 (20.44)	198 (44.29)	98 (21.92)	60 (13.42)		
	Age group												
Male	18 – 20	15 (18.75)	42 (52.50)	17 (21.25)	6 (7.50)	.027*	.20	15 (18.75)	29 (36.25)	24 (30.0)	12 (15.0)	.029*	.20
(*n*=175)	21 – 23	10 (11.49)	46 (52.87)	9 (10.34)	22 (25.29)			10 (11.49)	34 (39.08)	14 (16.09)	29 (33.33)		
	>24	0 (0)	4 (50.0)	2 (25.0)	2 (25.0)			0 (0)	2 (25.0)	2 (25.0)	4 (50.0)		
Female	18 – 20	61 (22.63)	162 (59.12)	30 (10.95)	20 (7.29)	.420	.08	62 (22.63)	125 (45.62)	55 (20.07)	32 (11.68)	.42	.08
(*n*=447)	21 – 23	26 (16.35)	93 (58.49)	28 (17.61)	12 (7.55)			26 (16.35)	67 (42.14)	41 (25.77)	25 (15.72)		
	>24	3 (21.43)	7 (50.0)	3 (21.43)	1 (7.14)			3 (21.43)	6 (42.86)	2 (14.29)	3 (21.43)		
Study level	Associates	76 (23.03)	184 (55.76)	44 (13.33)	26 (7.88)	.010*	.14	76 (23.03)	142 (43.03)	66 (20.0)	46 (13.94)	.006*	.14
	Bachelor's degree	40 (13.70)	170 (58.22)	45 (15.41)	37 (12.67)			40 (13.70)	121 (41.44)	72 (24.66)	59 (20.21)		
Male	Associates	15 (17.65)	45 (52.94)	17 (20.0)	8 (9.41)	.033*	.22	15 (17.65)	34 (40.0)	21 (24.71)	15 (17.65)	.107	.19
(*n*=175)	Bachelor's degree	10 (11.11)	47 (52.22)	11 (12.22)	22 (24.44)			10 (11.11)	31 (34.44)	19 (21.11)	30 (33.33)		
Female	Associates	61 (24.90)	139 (56.73)	27 (11.0)	18 (7.35)	.036*	.14	61 (24.90)	108 (44.08)	45 (18.37)	31 (12.65)	.031*	.14
(*n*=447)	Bachelor's degree	30 (14.85)	123 (60.89)	34 (16.83)	15 (7.43)			30 (14.85)	90 (44.55)	53 (26.24)	29 (14.36)		

Abbreviations: UW, underweight; NW, normal weight; OW, overweight; OB, obese; CV, Cramer's V
*$p < .05$ for Pearson chi-square test

expected that the prevalence of overweight and obesity based on the WHO classification would be lower than the Asian cutoff, as the latter used a lower value. The combined prevalence of overweight and obesity based on Asian cutoff for the study sample was remarkably high, 39.1%. This number showed some increasing trend in overweight and obesity prevalence when it is compared with the prevalence study conducted among Malaysian university students in 2019, prior to the pandemic, which was 21.2% and 16.3% (38.5%) (Wan Mohamed Radzi et al. 2019). A similar trend was obtained in the findings of Tan, Tan and Tan (Tan, Tan, and Tan 2021b), who reported that weight gain was observed among Malaysian and Indonesian university students in the first 4 months of confinement due to the pandemic. The Malaysian university students in the current study displayed a higher overweight and obese percentage than university students in Saudi Arabia (33.3% in June 2020) (Jalal et al. 2021), Southern Morocco (26.4% in March/June 2020) (Boukrim et al. 2021) and China (32.3% in April/May 2020) (Jia et al. 2021). It is speculated that the confinement due to MCO at the time of data collection has indirectly given a huge impact on the less physical activity and less movement, thus less calorie expenditure, hence contributing to weight gain among these university students.

Generally, university years denote transition time experienced by young adults, which includes adaptation to new environment and lifestyle. In this pandemic situation, the challenge is added with severe physical inactivity due to hours of teleconference lectures and assignments (Martínez-de-quel et al. 2021). These students practiced a sedentary lifestyle, which led to weight gain, overweight and obesity. It is typical for university students to exhibit some weight gain during the course of their education (Deliens et al. 2014). Physical inactivity due to extended sitting time during FDL at home and engagement in emotional eating are the contributing factors of weight gain among university students during this pandemic period (Reyes-Olavarría et al. 2020; Kriaucioniene et al. 2020).

In this present study, male students had significantly higher mean value for BMI than female students in age groups differences, those above 24 years old had significantly higher mean value than the younger groups among male students. The mean values for the three age groups were in overweight and obese categories. However, in female students, the BMI mean values were in a similar distribution in the normal weight category. The prevalence of BMI in age groups revealed that a significant difference among male students in both WHO and Asian cutoff points, but not among females. The results observed a higher prevalence rate of overweight and obesity among males than females based on WHO classification. A similar trend was reported in studies involving university and college students (Ren et al. 2015; Peltzer et al. 2014; Al-Ghabban 2013). In social terms, it is more justified for these young men to be overweight or obese than for females. Strength, being perceived as the symbol of men's masculinity among Asians, can be mistakenly related to being overweight and obese. Males receive pressure and internalisation of ideal muscular bodies greater than females (Izydorczyk et al. 2020; Frederick, Fessler, and Haselton 2005). On the other hand, a petite figure is highly valued among females, thus their motivation to control their diet in maintaining their desired body size. As for age groups distribution, the older the age groups, the higher the BMI of male students.

The BMI, as well as the prevalence of overweight and obesity, was significantly higher among bachelor's degree students. Similar findings were reported in terms of higher percentage of overweight/obesity with higher study level (Peltzer et al. 2014; Tapera et al.

2017). In terms of gender, bachelor's degree male and female students displayed significantly higher prevalence of overweight and obesity than associate degree students for WHO classification. However, in Asian classification, the males did not differ significantly for level of study, but the prevalence of being overweight and obese was higher among female degree students. The outcomes are ascribed to the higher level of stress in pursuing bachelor's degree than associate degree level of study. Linkages have been made between stress and BMI among university students (Amr et al. 2019), whereby stress contributes to weight gain (Khushboo and Shuchi 2012; Harding et al. 2014). The same may be experienced by the sample in this present study.

It must be highlighted that the current study adopted a web-based self-administrated survey because face-to-face data collection was not feasible during the COVID-19 pandemic. Therefore, one of the obvious limitations was being unable to contact individuals who had limited internet access. In addition, the findings from the current study might not represent the prevalence of all university students in Malaysia since samples were only selected from two public universities in Sarawak, Malaysia. Reporting bias was a possibility as the researchers could not guarantee the accuracy of the participants' online survey answers; however, the high usage of online platforms during this time frame may have improved the accuracy of the answers. Another limitation of the study was that information about the ethnic group of each student was omitted. As a consequence, it was impossible to determine any differences in the prevalence of overweight and obesity according to ethnicity.

Conclusion

This is the first study conducted among university students attending two public universities in Sarawak, Malaysia, during the pandemic. A high prevalence of overweight and obesity was found among the university students, particularly the males. Almost a quarter of the students were either overweight or obese. Older age groups were more prominent in terms of the prevalence of overweight and obesity in these categories. Bachelor's degree students had higher BMI scores than associate degree students, and the difference in prevalence between males and females was significant. This study represents the first step towards a more tailored, accessible and effective approach to tackling obesity among university students. We advocate employing the Asian classification to define obesity and overweight among Malaysian university students. This is because the percentages of overweight and obesity for this population appeared lower when WHO classification is used. This may underestimate the actual prevalence of body weight status in this population.

Disclosure statement

No potential conflict of interest was reported by the author(s).

ORCID

Patricia Pawa Pitil http://orcid.org/0000-0001-8562-5904

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Appendix 13: Publication 4

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Acceptance and Commitment Therapy and Weight-Related Difficulties in Overweight and Obese Adults: A Systematic Review

Patricia Pawa Pitil
Faculty of Medicine & Health Sciences, Universiti Malaysia Sarawak, Kota Samarahan, Malaysia

Faculty of Sports Science & Recreation, Universiti Teknologi MARA Sarawak Branch, Kota Samarahan, Malaysia

Siti Raudzah Ghazali
Faculty of Medicine & Health Sciences, Universiti Malaysia Sarawak, Kota Samarahan, Malaysia

Abstract

Multiple studies have investigated the efficacy of acceptance and commitment therapy (ACT) in improving psychological flexibility among overweight and obese individuals. However, to date, no specific reviews have focused on ACT and weight-related difficulties in this population. This systematic review of the literature aims to identify and assemble all ACT interventions in randomized controlled trials (RCT) that address weight-related difficulties in the treatment of overweight and obese adults. The PRISMA 2020 framework was used for the systematic review, includes manual and computerized database searches. Five databases (Medline, PubMed, Scopus, PsycInfo, and Google) were utilized to gather all articles that: (a) published in English; (b) adopted the RCT design; (c) used ACT as an intervention; (d) included adult participants aged over 18 years with BMI of over 25 kg/m^2, and (e) included weight-related difficulties and weight as outcome measures. The review identified seven studies comprising 698 overweight or obese participants of both genders. Improvements were reported in weight-related difficulties and percentage of weight loss in the ACT group and the non-

Corresponding Author:
Siti Raudzah Ghazali, Faculty of Medicine & Health Sciences, Universiti Malaysia Sarawak, Jalan Datuk Mohammad Musa, Kota Samarahan 94300, Malaysia.
Email: gsraudzah@unimas.my

ACT group. The present review supports ACT as an effective intervention that can help adults with weight-related difficulties and excess body weight. Further studies should be conducted in various overweight or obese populations with a more systematic RCT research design to establish the effectiveness of ACT in this area.

Keywords
acceptance and commitment therapy, overweight, psychological flexibility, systematic review, weight-related difficulties

Introduction

Overweight and obesity are conditions that are described as having an abnormal or excessive accumulation of fat, which poses a health risk. Overweight is defined as a body mass index (BMI) greater than 25, while obesity is defined as a BMI greater than 30. Over four million annual deaths from being overweight or obese, as per the global burden of illness (WHO, 2017). This problem has increased dramatically in recent decades (OECD, 2019; Vardell, 2020). Due to the severity of the situation, there has been increased attention on body weight. There was a three-fold dramatic growth in obesity prevalence globally from 1975 to 2016. In 2016, over 650 million adults aged 18 and above were reported as obese, which made up 13% of the total adult population worldwide (11% of men and 15% of women (WHO, 2017)).

Numerous non-communicable diseases, such as cardiovascular diseases, diabetes, musculoskeletal disorders, and several cancers, are connected with excessive body weight, and these conditions would greatly impact the quality of life (WHO, 2022). Numerous psychological factors contribute to weight gain. For example, emotional eating, impulsive eating, and rigid control over one's eating habits may be signs of experiential avoidance linked to weight, which would affect one's quality of life (Lillis et al., 2014; Palmeira et al., 2018). Weight-related experiential avoidance is a psychological condition when a person tries to avoid, control, or change unpleasant internal experiences related to weight and eating, such as food cravings, tiredness, and feeling bad about their own weight (Lillis et al., 2009).

Several factors can contribute to body weight struggles. A combination of biological, genetic, social, environmental, and behavioral factors contribute to obesity (Allison et al., 2008). The environment (such as obesogenic surroundings and chemicals) and behaviors of an individual can alter the genetic factor, which influences biological processes (e.g., caloric patterns and sedentary lifestyle habits). Therefore, it increases the susceptibility of individuals toward obesity (Kadouh & Acosta, 2017; Lee et al., 2000).

The approaches to address overweight or obesity issue have been established. Three strategies exist for successfully maintaining body weight or losing weight: a nutritious diet, physical exercise, and behavioral changes (Ruiz, 2010). These strategies often

combine food and physical activity recommendations with proven approaches for behavioral change, such as goal planning, self-observation, problem-solving, and scheduled social support. There are also medical interventions for weight loss including prescription drugs (Tchang et al., 2021) and bariatric surgery (Wolfe et al., 2016). However, these approaches are mostly used among very high-risk populations and under the clinical supervision of physicians; thus, they are not covered in this review.

As weight loss is regarded as the primary objective, psychological effects are rarely addressed. An emerging and potentially effective behavioral method for a range of psychological concerns associated with body weight issues is the third wave of Cognitive Behavioral Therapy (CBT), specifically Acceptance Commitment Therapy (ACT). Compared to other kinds of CBT, this intervention treatment provided the most consistent evidence of efficacy for weight management (Hayes et al., 2001). To date, CBT has been recommended for treating obesity in weight management behavior (Byrne et al., 2004; Cooper et al., 2010; Moffitt et al., 2015). Contradictory findings regarding CBT's ability to maintain weight loss (Castelnuovo et al., 2017) and also ineffective in targeting the emotional issues of individuals struggling with body weight (Comş;a et al., 2020) however, have also been reported.

ACT is a therapeutic approach to developing psychological flexibility, and it focuses on negative human language and cognition. It is rooted in a functional contextual philosophy (Biglan & Hayes, 1996; Hayes et al., 1993) and hypothetically ingrained in the framework of the relational frame theory (RFT) (Ruiz, 2010). RFT is a vigorous and comprehensive experimental analysis of human language and cognition (Hayes et al., 2001). It emphasizes context, distinguishing between contexts that establish cognitive networks, and those that determine the functions of these networks. ACT aims to modify cognition, emotions, memories, and bodily sensations to a level that increases their functional importance. By encouraging acceptance and mindfulness, ACT seeks to improve healthy behavioral patterns that are congruent with personal values in the context of treating obesity (Lillis & Kendra, 2014; Wilson, 2020).

There has been an increasing interest in acceptance-based interventions to endorse flexible behaviors in dealing with body weight, as well as the maintenance of healthy body weight via physical activity and the commitment towards it. The use of ACT is based on empirical research implying that psychological flexibility has a significant relationship with a reduction in body weight (Forman et al., 2009; Katterman & et al., 2014; Tapper et al., 2009). Weight-related psychological flexibility should be the expected change in the ACT intervention for weight management among overweight and obese people. To further validate the effects of ACT on weight-related psychological flexibility (which will be referred to as weight-related difficulties) and obesity, it is critical to synthesize the findings of the previous studies' findings.

Previous studies have suggested that experiential avoidance of individuals with excess body weight can lead to several health behaviors: eating disorder behaviors, body image dissatisfaction, and psychological stress (Lillis et al., 2011; Lillis & Hayes, 2008; Weineland et al., 2013). As reported in several studies, ACT intervention had its limitations but produced some successful outcomes in helping overweight and obese

individuals. For example, one study conducted on a brief ACT workshop intervention was able to improve weight-related difficulties and reduce binge eating frequency, as well as promote physical activity increment by more than 30 minutes per week (De Freitas et al., 2017). Similarly, the effects on weight and intuitive eating were mediated by mindfulness abilities and psychological adaptability among overweight adults at 36 weeks post-baseline (Sairanen et al., 2017). Another study (Lillis et al., 2017) conducted a one-year intervention with a follow-up at 24 months and discovered significant weight loss and an improvement in weight-related psychological flexibility; participants of their study experienced reduced weight-related difficulties. A detailed review of these studies including the number of sessions and duration of the intervention will be explored to examine the benefits of ACT on the variables of interest.

Experiential avoidance has been associated with difficulties in maintaining important behavioral changes such as weight loss (e.g., evaluating one's weight or appearance negatively, feeling that one will always be overweight, and perceiving that being overweight is not good). ACT may facilitate accepting the struggle that comes with excess body weight and offer a deeper understanding into the process, enabling the individual to continue working towards their weight loss goal. In addition, the ACT's effectiveness has been observed to decrease self-stigma (Griffiths et al., 2018), binge eating frequency (Manlick et al., 2013), chronic pain (Lin et al., 2019), and substance abuse (Osaji et al., 2020). Analyses results suggest that these effects are due to changes in psychological flexibility. Therefore, the overall effectiveness of ACT among overweight or obese people and weight-related difficulties and weight loss should be explored more thoroughly. To the best of our knowledge, only two reviews have targeted the effects of ACT on weight management (Iturbe et al., 2022; Lawlor et al., 2020). In the review done by Lawlor et al. (2020), weight loss was observed in the ACT intervention group up to 12 months. However, psychological analysis was not performed, making it difficult to explain the psychological changes in the weight-related difficulties. On the other hand, Iturbe et al. (2021) reviewed the effects of ACT on psychological well-being alongside weight loss, but elaborated tremendously on the many aspects of psychological well-being and did not focus much on weight-related difficulties.

Therefore, the current review systematically evaluates the effectiveness of ACT among the overweight or obese population with regard to weight-related difficulties. The high prevalence of obesity among adults and the increasing evidence of psychological difficulties among this population stresses the importance of ACT as a treatment component in helping people affected by overweight and obesity challenges. This systematic review offers a comprehensive overview of the ACT intervention's implication size on two variables: the main outcome is weight-related difficulties and the secondary outcome is BMI using quantitative estimations.

Methods

In order to summarize the important aspects of the review, a literature review analysis was carried out. The papers were systematically gathered, examined, and summarized. The authors used the PRISMA 2020 framework to conduct a systematic literature review, and records were found using the Medline, PubMed, Scopus, PscyINFO, and Google Scholar databases. Manual searches of numerous websites, organizations, and citations were also found as sources of data using the thorough pearl search growth technique (Schlosser et al., 2006).

Studies selected in this analysis had the following inclusion criteria: (a) adopted an RCT design; (b) used ACT as the intervention; (c) conducted on adult participants aged over 18 years with BMI of over 25 kg/m^2, and (d) included BMI, weight, and weight-related difficulties as outcome measures. Studies with control groups were included to ensure that the search covered all pertinent criteria. The included studies must be published in English. Studies involving treatments like medications or surgery were excluded in this review, nor were studies that targeted a specific demographic (such as post-surgical patients or pregnant women), were not empirical, qualitative, or case studies, or were not published in peer-reviewed scientific publications.

Part 1: Database Search

Step 1. Papers selected: 152

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: The research articles were extracted using the electronic databases of Medline, PubMed, Scopus, PsycINFO, and Google Scholar (Figure 1). The search terms were "acceptance and commitment therapy" OR "ACT" OR "Acceptance-based therapy") AND ("weight-related flexibility" OR "weight-related psychological flexibility" OR "weight-related difficulties" OR "weight-related psychological difficulties") AND ("obese" OR "overweight" OR "body mass index"). Within the title and abstract of articles, the terms were searched for and the period from the earliest date available to 31 October 2022 (the search date) was specified. Next, 26 articles were excluded due to duplicate content, and 126 articles were chosen.

Step 2. Papers selected: 126

In Step 2, 51 records were excluded from the analysis, including online books, non-English articles, review studies, conference proceedings, and unpublished dissertations.

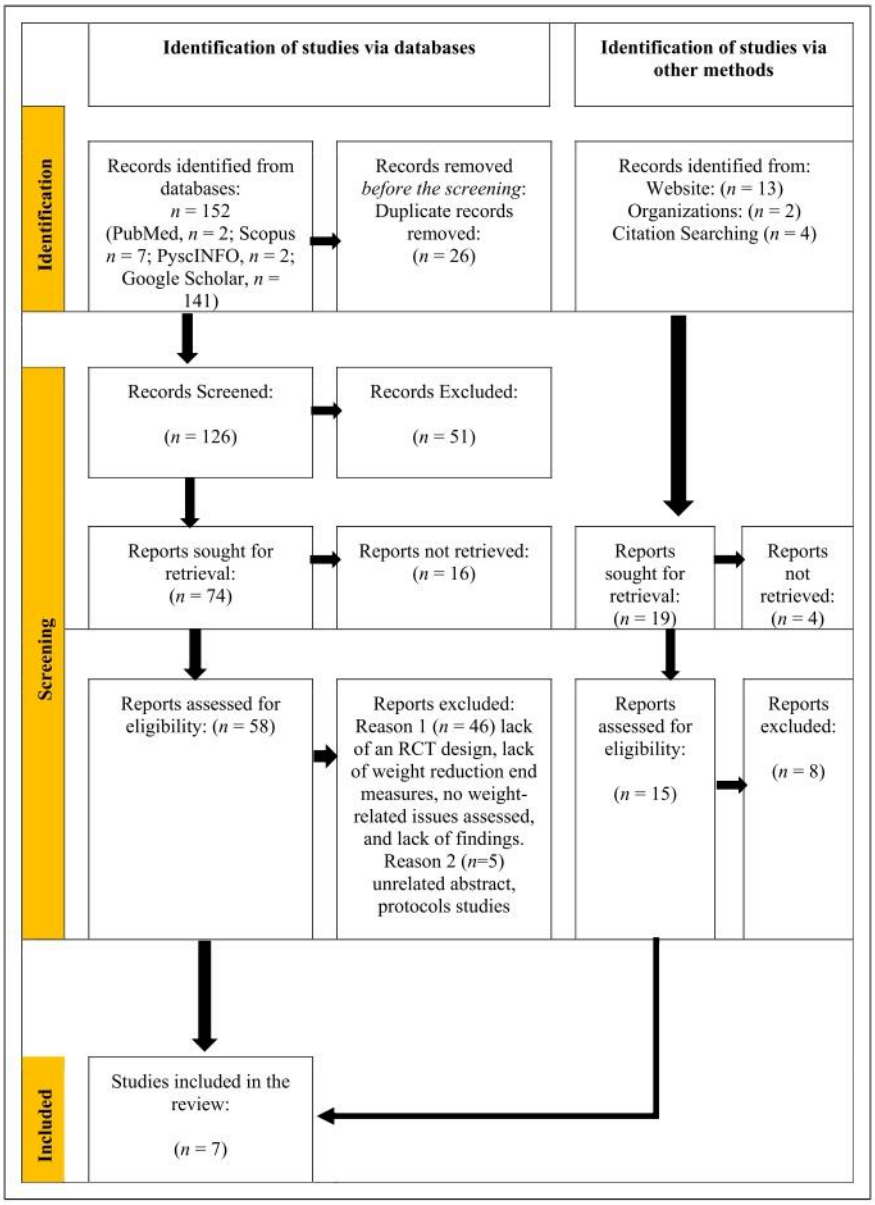


Figure 1. Flow diagram of systematic selection of papers in review.

Step 3. Papers selected: 74

Another 16 articles were disregarded from the study as they could not be retrieved after the initial 51 records were excluded from analysis.

Step 4. Papers selected: 58

Another 46 papers were omitted due to their lack of an RCT design, lack of weight reduction end measures, lack of weight-related issues assessed, and lack of findings. After a comprehensive evaluation of their abstracts and contents, five articles were deleted. The articles were eliminated because they were irrelevant to the topic of the study. The quantitative synthesis included seven research studies.

Step 5. Papers selected: 7

Finally, seven articles were determined to be relevant to the present review.

Part 2: Manual Search

The "berry-picking approach" introduced by Bates (1989) was used for further research (Bates, 1989). The berry-picking approach can enrich information retrieval, which includes the following six strategies: (1) Footnote chasing (or backward chaining) is the process of locating footnotes in relevant books and articles and then going backward through reference lists; (2) citation searching (also known as forward chaining) begins with a citation, searches a citation index to find out who cited it, then moves on along the chain, checking for other citations; (3) using literature summaries to manually search pertinent journals, journal articles, or abstract series; (4) area scanning, which includes viewing items near those found earlier in a search; (5) using abstracting and indexing services as well as subject searches in bibliographies; and (6) author searching in the study area.

Step 1. Papers selected: 13

A technique called "comprehensive pearl growing" is incorporated into the search strategy. The first stage in pearl expansion is to identify the "key pearls" (important studies) discovered during the literature review that are pertinent to the study's main goal. (Schlosser et al., 2006). The author took into account "acceptance and commitment treatment" (ACT), "obesity," and "weight-related issues" as the key pearls.

Step 2. Papers selected: 4

Citation searching and footnote chasing were employed to gather the other set of relevant articles for the current study based on the research topic and objectives.

Step 3. Reports from organizations selected: 2

Searches were conducted on the websites of relevant government agencies and international organizations to obtain the related government reports for acceptance and commitment therapy (ACT) for overweight people. To better comprehend the goal of the current systematic literature review, reports from the World Health Organization (WHO), the Association for Contextual Behavioral Science (ACBS) Malaysia Chapter, and the Australian Association of Social Workers (AASW) were analyzed. The final paper selection from the preceding steps in parts one and two resulted in a total of seven papers. Figure 1 describes the systematic flow of paper selection.

The following is the description of the article's structure.

This review has identified seven studies that utilized the RCT (Afari et al., 2019; Lillis et al., 2009, 2015, 2021; Palmeira et al., 2018; Potts et al., 2022; Sairanen et al., 2017). Table 1 comprises the list of selected papers as well as comprehensive authors' information, participants, details of the intervention, control, the primary outcome measures identified from the literature review, and the primary findings identified from the study articles.

Results

Study Characteristics

Seven studies comprising 698 overweight or obese participants of both genders were selected for this review. The articles were published between 2009 and 2022 (Table 1). All studies were published in peer-reviewed journals. The participants' average BMI across the studies ranged from 31.3 – 37.6 kg/m^2, which was mid-range in the obese group. Five studies were carried out in the United States of America (Afari et al., 2019; Lillis et al., 2009, 2017; Potts et al., 2022; Schumacher et al., 2019), one in Finland (Sairanen et al., 2017) and one in Portugal (Palmeira et al., 2017). Two studies recruited overweight and obese women (Lillis et al., 2017; Palmeira et al., 2017), while the other four studies recruited overweight and obese mixed-gender participants (Afari et al., 2019; Lillis et al., 2009, 2021; Potts et al., 2022). One study did not report the sex of their participants (Sairanen et al., 2017).

Despite the broad inclusion criteria, only a number of studies met the eligibility criteria. From our findings, the studies were varied: a) duration of the ACT interventions (25 sessions over 12 months, 32 sessions over 12 months, six sessions for eight weeks, 10 weekly sessions - plus two booster sessions for three months, eight sessions for 12 weeks, eight weekly sessions for eight weeks, one-day of ACT intervention); b) measured to evaluate weight-related difficulties and c) body weight was assessed in baseline, post-intervention, and several follow-ups in several studies.

Table 1. Data Extraction Table Of Included Studies.

Author	Participants	Details of Intervention	Control	Outcome Measures	Primary Findings
Potts et al. (2022)	*Population:* Adults residing in the United States ($N = 55$) Gender: 18.2% male, 81.8% female Age: 18–64 years, ($M = 38.65$, $SD = 12.40$) Ethnicity: 89.09% non-Hispanic/Latino white, 5.45% hispanic/Latino white, 3.64% hispanic/Latino of other race, and 1.82% black BMI: 37.01 kg/m^2, $SD = 6.51$	Eight weeks of guided self-help with phone coaching (GSH-P) or guided self-help with email prompts (GSH-E) utilizing the diet trap self-help book to teach ACT skills to reduce effects of weight self-stigma, improving quality of life (eating behavior, weight-management behavior, physical activity) and weight-related flexibility	Waitlist condition	1. Weight-related difficulties (22-item AAQ-W) 2. Weight self-stigma (WSSQ) 3. Weight management behaviors (WCSS) 4. Emotional eating (DEBQ-EE) 5. Binge eating (EDE) 6. Physical activity (IPAQ-SF) 7. Weight (BMI) *Timing of administration* Pre and post-treatment (8 weeks)	Both GSH-P and GSH-E improved weight self-stigma than waitlist condition. The GSH-P improved more on eating behaviors and physical activity. BMI, emotional eating, and physical activity revealed no difference between GSH-P and GSH-E Weight loss: −7.12% (GSH-P) and −5.82% (GSH-E) from baseline to week 8 *Attrition:* 0%
Lillis et al. (2021)	Population: Adults ($N = 102$), who had received a 12-week online weight-loss intervention Gender: 70% female, 30% male Age Ethnicity	A 1-day, five-hour workshop based on ACT. Follow-up at three months	Self-regulation (SR) intervention group and control group SR intervention: Based on wing et al. (Wing et al., 2006). There are three components: Self-observation, self-evaluation, and self-reinforcement	1. Weight-related difficulties (22-item AAQW) 2. Values-consistent behavior (The Bull's eye) 3. Weight (BMI) *Timing of administration* Pre and post-treatment (6, 12, 18, and 24months)	All the groups decreased in weight-related difficulties but no significant differences between groups Values-consistent behavior changed significantly greater in the ACT group than SR group. Both ACT and SR groups did not differ from the control group ACT group and SR group did not differ significantly in weight loss at 24-month, however, ACT group and CG was significant Weight loss: −7.18% in the ACT group, −4.18% in the SR group, −1.15% in the control group at 24 months *Attrition:* 42% for the control group, 0% for the ACT group and SR group at 24 months

(continued)

Table 1. (continued)

Author	Participants	Details of Intervention	Control	Outcome Measures	Primary Findings
Afari et al. (2019)	*Population:* Veterans who completed the MOVE! weight management program (*N* = 88) *Gender:* 67 male, 21 female *Age:* 18–75 years (*M* = 57.3, *SD* = 9.9) *Ethnicity:* 17 african-american, 62 caucasian, 12 hispanic *BMI* = 37.2 kg/m^2, SD = 7.0	Eight-week of 12 sessions of ACT protocol using mindfulness and acceptance strategies to address eating behavior and weight-related difficulties	BWL intervention: Psychoeducational component using *MOVE!* on medical, nutrition and weight loss strategies	1. Binge eating (BES) 2. Eating behavior (DEBQ) 3. Obesity-related QoL (ORWELL-97) 4. Weight-related difficulties (20-item AAQ-W) 5. Weight	The ACT group and BWL group improved in all measures at post-intervention, 3-month and 6-month follow-up (no significant difference between groups) Weight loss: −0.9% (ACT group), −1.36% (BWL group) *Attrition:* 1.14% from BWL group at 6-month follow-up (1 out of 88)
Lillis et al. (2017)	*Population*: Obese adults (*N* = 162) *Gender*: 138 females, 24 males *Age*: 18–70 years (*M* = 50.25, *SD* = 11.0) *Ethnicity:* 8 african-american, 7 hispanic, 2 asian, 142 caucasian BMI = 37.6 kg/m^2, *SD* = 5.35	A total of 32 sessions across one year in a faded contact design of the acceptance-based behavioral intervention (ABBI) (ACT group) taught acceptance, mindfulness, and values-based techniques to address negative thoughts, emotions, and food cravings	Standard behavioral treatment (SBT) (non-ACT) intervention: Cognitive techniques to deal with unpleasant thoughts, feelings, and food cravings that could limit weight loss. Relaxation and distraction strategies were also taught to help minimize stress and avoid impulsive eating	1. Weight-related difficulties (22-item AAQ-W) 2. Eating behavior (eating inventory) 3. Values-consistent behavior (The Bull's eye) 4. Strategies to maintain or lose weight (WCSS) 5. Weight (BMI) *Timing of administration* Pre-intervention, 6, 12,18, and 24 months	Both groups improved in all measures across 24 months, with no significant difference between groups. Only values-consistent behavior scores had a greater increase in the ACT group than in the SBT group Weight loss: −4.2% (ACT group) and −2.4% (SBT group) from baseline to 24 months *Attrition:* 0%

(continued)

Table 1. (continued)

Author	Participants	Details of Intervention	Control	Outcome Measures	Primary Findings
Palmeira et al. (2017)	*Population:* Overweight or obese women (N = 73) *Age*: 18–55 years (M = 42.35, SD = 8.79) *Ethnicity*: Not mention BMI = 34.24 kg/m^2, SD = 5.04	Ten weekly plus two booster fortnightly group sessions of 2.5 hours (3.5months) of KG-free intervention based on mindfulness, ACT, and compassion-based approaches for overweight and obese	Treatment as usual (TAU) which included nutritional and medical appointments	1. Weight-related difficulties (AAQW-R 10-item) 2. Weight self-stigma (WSSQ) 3. Obesity-related QOL (ORWELL-97) 3. Eating behavior (TFEQ-R21) 4. Tendency to criticize self (FSCRS) 5. Self-compassion (SCS) 7. Mindfulness characteristics (FFMQ) 8. Weight (BMI) *Timing of administration* Pre-intervention and after post-intervention (week 12)	ACT (kg-free) group decreases in all measures, and improved in obesity-related QOL at post-treatment significantly than the control group Weight loss: −1.99% in ACT group, --0.1% in control group at 3.5 months *Attrition* 14 of 73 dropped out (19.2%) (9 of 36 in ACT group and 5 of 37 in control group)
Sairanen et al. (2017)	*Population* Overweight or obese adult women (N = 219) *Age*: 25–60 years (M = mean age = 49.5, SD = 7.4) *Ethnicity*: Not mentioned BMI = 31.3 kg/m^2, SD = 2.9	ACT F2F The eight-week, six-session, 90-minute ACT intervention was designed to encourage lifestyle changes and improve well-being by committed actions based on personally significant values ACT mobile intervention: The application presented an ACT-based intervention program identical to the F2F group.	Waitlist condition	1. Weight-related difficulties (22-item AAQ-W) 2. Psychological flexibility (AAQ-II) 3. Intuitive eating (IES) 4. Mindfulness (FFMQ) 5. Sense of coherence (SOC-13) 6. Weight (BMI) *Timing of administration* Pre-intervention, post-intervention (week 10), and 36-month follow-up	Weight-related difficulties decreases significantly in ACT F2F and mobile groups during the interventions than in the CG. The psychological flexibility did not significantly improve at post-intervention in ACT groups and CG. One component from IE (eating for physical rather than emotional responses) increased significantly in ACT F2F group and mobile group than CG in post-intervention, but not in the follow-up Mindfulness skills increased more in ACT mobile group than ACT F2F group Weight loss: −2.26% in ACT F2F group, −1.6% in ACT mobile group,-0.6% in control group at 36 months *Attrition* Not reported

(continued)

Table 1. (continued)

Author	Participants	Details of Intervention	Control	Outcome Measures	Primary Findings
Lillis et al. (2009)	*Population* Overweight or obese adults (N = 87) Gender: 76 females, 8 males Mean age: 50.25, SD = 11.25 *Ethnicity* Caucasian (ACT, 38; control, 39) African american (control, 2), hispanic/Latino (ACT, 2; control, 2), multiracial (control, 1) BMI: 33.04 kg/m^2, SD = 7.15	One-day, six-hour ACT workshop	Waitlist condition	1. Weight-related difficulties (22-item AAQW) 2. Psychological distress (GHQ) 3. Obesity-related quality of life (ORWELL) 4. Weight-related stigma (WSQ) 5. Weight (BMI) *Timing of administration* Pre-intervention, post-intervention (not mentioned), and three-month follow-up	Decreased in all measures, improved in obesity related-quality of life in ACT group than control group at three-month follow-up Weight loss: −1.16% in ACT group, +0.6% in control group at three months *Attrition* Three participants in the ACT group dropped out before the workshop (97% of participants completed the study)

Abbreviations: AAQ-W, acceptance and action questionnaire for weight-related difficulties; AAQ-II, acceptance and action Questionnaire-II; BES, binge eating scale; BMI, body Mass index; DEBQ-EE, Dutch eating behavior questionnaire – Emotional eating; EDE-Q, eating disorders examination questionnaire; FFMQ, five facet mindfulness questionnaire; FSCRS, forms of Self-Criticizing/Attacking and self reassuring scale; IPAQ-SF, international physical activity questionnaire-short form; IES, intuitive eating scale; ORWELL-97, obesity related well-being questionnaire – 97; SCS, self-compassion scale; SOC-13, sense of Coherence-13; TFEQ-R21, three-factor eating questionnaire-revised-21: WSSQ, weight self-stigma questionnaire; WCSS, weight control strategies scale; 22-item AAQW, 22-item acceptance and action questionnaire for weight-related difficulties

Intervention

All selected studies used ACT programs that were adapted from other studies and books. Lillis et al. (Lillis et al., 2021) utilized the ACT intervention from a study they had conducted earlier (Lillis et al., 2009), which is also included in this review. One study (Afari et al., 2019) adopted an intervention based on a piloted ACT study (Cuneo et al., 2018), and another study (Lillis et al., 2017) used the intervention from Acceptance Based Behavioral Intention (ABBI) (Hayes & Lillis, 2012; Lillis et al., 2014). Next, one study (Sairanen et al., 2017) applied the intervention used in a study examining ACT in metabolic syndrome and psychological distress among obese individuals. Two studies utilized materials from ACT books. One study (Potts et al., 2022) utilized the self-help book The Diet Trap (Lillis et al., 2014), while the other study (Lillis et al., 2009) utilized the earliest ACT book (Hayes et al., 1999) as the ACT intervention. The only study (Palmeira et al., 2017) developed their own ACT intervention based on the pre-existent ACT books (Hayes & Smith, 2005) and manuals for eating and weight issues (Forman et al., 2013; Lillis et al., 2009)

Measures

All studies measured weight post-intervention and in their follow-up assessment and utilized an assortment of measures to assess weight-related difficulties. All studies used Acceptance and Action Questionnaire for Weight-Related Difficulties (AAQ-W) to assess weight-related difficulties; five studies utilized the original version of the 22-item AAQ-W (Lillis et al., 2009, 2017, 2021; Potts et al., 2022; Sairanen et al., 2017). The other two studies utilized the revised version of the AAQ-W: 20-item AAQ-W (Afari et al., 2019) and 10-item AAQ-W (Palmeira et al., 2017).

Besides the two main outcomes of this review, the other assessments were eating behavior (Lillis et al., 2017; Potts et al., 2022), obesity-related quality of life (Afari et al., 2019; Lillis et al., 2009; Palmeira et al., 2017), and value-consistent behavior (Lillis et al., 2017, 2021). There were also measures of physical activity (Potts et al., 2022), self-criticize, self-compassion, and mindfulness (Palmeira et al., 2017). Additionally, psychological flexibility (Sairanen et al., 2017) and psychological stress were evaluated (Lillis et al., 2009).

Two studies tested the ACT intervention in a one-day workshop (Lillis et al., 2009, 2021). One study was conducted for four weeks (Afari et al., 2019), two were conducted for eight weeks (Potts et al., 2022; Sairanen et al., 2017), one for 10 weeks (Palmeira et al., 2017); and the longest intervention was over a year (Lillis et al., 2017).

The time frames for measuring the outcomes varied across all studies. Potts et al. (2022) measured the outcome at an eight-week post-intervention, while Lillis et al. (2009) evaluated their outcomes at a three-month follow-up. In a study by Palmeira et al. (2017), outcome measures were conducted on month 3.5 after the intervention ended. Meanwhile, Afari et al. (2019) measured the outcome at week one post-intervention, three-month and six-month follow-up. Lillis et al. (2021) measured the

outcomes at three, six, 12, 18, and 24-months. For Lillis et al. (2017), the measurement was done at baseline, six, 12, 18, and 24 months, for one year of 32 sessions. Sairanen et al. (2017) followed up directly after post-intervention, week 10, and at a 36-week follow-up after the baseline.

All studies utilized an RCT design. Two studies (Afari et al., 2019; Palmeira et al., 2017) applied computer-based randomization to the participants, while one study (Potts et al., 2022) assigned their participants by Qualtrics to one of the three conditions with equal allocation, 1:1 without blocking or stratifying any variables. In one study, the participants were randomized by stratification by sex (Lillis et al., 2021). However, the other three studies did not describe the randomization method in detail. Thus, selection bias could not be ruled out. Two studies compared two ACT interventions with CG (Potts et al., 2022; Sairanen et al., 2017), while the remaining five studies directly compared an ACT intervention group with CG (Afari et al., 2019; Lillis et al., 2009, 2017, 2021; Palmeira et al., 2017).

As blinding of participants was not possible in psychological intervention, the clinical psychologists who conducted the treatment participants' data collection were blinded in one study (Palmeira et al., 2017). The remaining six studies did not perform any blind conditions, either during data collection, or the treatment givers. Attrition rates was highest at 42% in control group at 24-month follow-up (Lillis et al., 2021), 34.5% at eight-week post intervention (Potts et al., 2022), followed by 19.2% at post-intervention at 3.5 months (Palmeira et al., 2017), 3% at three-month follow-up (Lillis et al., 2009) and the lowest was 1.14% at 6-month follow-up (Afari et al., 2019), while Sairanen et al. (2017) did not report any attrition. In terms of assessment points, three studies (Palmeira et al., 2017; Potts et al., 2022) did not conduct follow-up while the others did. These assessments ranged between two (Potts et al., 2022) to 24 months (Lillis et al., 2021)

Except for two studies (Afari et al., 2019; Sairanen et al., 2017), all other studies conducted a power analysis. Only two studies (Afari et al., 2019; Palmeira et al., 2017) performed an intent-to-treat analysis. Data analyses were described in all studies. Palmeira et al. (2017) described a substantial medium-effect-sized difference at baseline in the ACT group in comparison to the control group (TAU) regarding weight-related difficulties and self-criticism. At the baseline, there was no significant difference between the scores on the group outcome measures and the other key variables. On the other hand, Lillis et al. (2009) reported a significant difference between the ACT and control group at baseline in terms of previous success in weight loss with dieting. However, the authors addressed this adequately by including past dieting success as a covariate in the analysis. The remaining key variables at baseline were not significantly different in the other five studies.

In all of the studies, biased sources were identified, and attention control was not applied in any study. Four studies (Afari et al., 2019; Lillis et al., 2009, 2017, 2021) highlighted the competencies and expertise of therapists when examining the interventions. The group leaders' experience and qualifications in relation to the intervention were also outlined. The competency levels of the therapists were not indicated

in the other three studies. Therefore, it is questionable whether the intervention's positive outcomes were a result of utilizing ACT techniques or as a consequence of receiving any form of intervention. The therapeutic relationship between therapists and participants might have also manipulated the intervention effects. Even though one study (Potts et al., 2022) utilized ACT intervention via self-help email and phone, the competency of the ACT interventionist was doubtful; this would have influenced the intervention effects.

The likelihood of biased reporting is minimal since all studies disclosed the findings of all methodological variables, explained how the data were analyzed, and indicated the number of participants who were included in the study.

Primary Findings

The principal summary measures were mean differences between intervention and control groups or, pre- and post-intervention and follow-up scores in some studies. Effect sizes and *p*-values were stated. From the seven studies examined, the analyses of variations in post-intervention outcome measures of weight-related difficulties and BMI exposed these studies exhibited a noteworthy ACT's effect relative to the control group (CG) or non-ACT intervention. The exception was two studies in which they had three conditions (Lillis et al., 2021; Potts et al., 2022) with small to large Cohen's *d*-effect sizes (weight-related difficulties and BMI). If $d > 0.2$ or less, the effect size is small, $d > 0.5$ is medium, and $d > 0.8$ is large (Cohen, 1977).

For weight-related difficulties changes, three studies with the large effect size between conditions (ACT group vs. CG) were Potts et al. (2022) (GSH-P vs. CG, $d = 1.43$; GSH-E vs. CG, $d = 1.12$), Lillis et al. (2009) ($d = 1.34$) and Palmeira et al. (2017) ($d = 0.96$). Three studies reported small to moderate effect sizes [$d = -0.33$, ACT F2F versus CG; $d = -0.20$, ACT mobile versus CG (Sairanen et al., 2017), $d = 0.15$ (Afari et al., 2019), and $d = 0.12$ (Lillis et al., 2017)]. One study did not provide sufficient results to report the effect size (Lillis et al., 2021).

In one study that used a pilot intervention, the ACT intervention was given after the 12-week weight loss program (Lillis et al., 2021). This showed that weight loss had the biggest effect. The 24-month follow-up revealed a decreased weight of −7.18% (vs. −4.18% SR, −1.15% CG). The high weight loss also was reported in a study (Potts et al., 2022) utilizing the self-help book of ACT, The Diet Trap (Lillis et al., 2014), by phone coaching (−7.12%) or email prompts (−5.82%) in an eight-week post-intervention. A promising weight loss appeared in a study lasting one year (Lillis et al., 2017). The ACT group lost 4.2% of their weight after a 24-month follow-up. A subsequent study used an eight-week ACT intervention in two approaches—ACT face-to-face (F2F) (−2.26%) and ACT mobile (−1.6%)—and found a small weight reduction in the post-intervention period (Sairanen et al., 2017). Unlike the latest study by Lillis et al. (2021), their earlier study (Lillis et al., 2009) of a one-day ACT workshop found a small weight loss (−1.17%) in the ACT group (vs. CG, +0.06%). Even though these studies provided a one-day ACT workshop to their participants, the included

weight loss program in the early phase of the study did help in greater weight loss among the ACT group. While all the studies observed greater weight loss in the ACT group, Afari et al. (2019) found a slightly lower difference in the ACT group (−0.9%) than the CG (−1.36%).

Taken together, these studies had limitations in methodology: the unclear randomization protocol in a few studies, homogeneity of participants of mostly overweight and obese Westerners, a wide age range of 18 to 75 years, and mostly female participants. Some mean scores of outcome measures were not reported at post-intervention or follow-up, affecting the effect size calculation.

The Effects of ACT on Weight-Related Difficulties And BMI

Potts et al. (2022) included 55 overweight/obese participants with high-weight self-stigma. They were allocated at random to one of the three groups: the ACT self-help book plus phone coaching group (GSH-P), the ACT self-help book plus email prompts only group (GSH-E), or a waitlist condition (CG). Online self-report assessments and post-intervention measurements were conducted eight weeks later. At the post-intervention, both intervention groups had decreased weight-related difficulties, but not the CG. Within-group changes from pre-to post-intervention, a large effect size was noted. However, BMI was not significant different within the ACT condition (−7.12% in GSH-P vs. −5.82% in GSH-E), similar to the other outcomes of emotional eating and physical activity. The decreased in BMI measurement from pre-to post-intervention should be noted in both ACT condition. Therefore, the phone coaching and email approach ought to be beneficial in delivering ACT intervention for health behaviors.

Lillis et al. (2021) recruited 102 (mean BMI = 34.4, SD = 4.3, mean age = 57.8, SD = 8.9; n = 31 males, n = 71 females) participants who received a 12-week online weight loss intervention and lost >5% to a one-day, five-hour workshop based on ACT, Self-Regulation (SR) or no workshop (CG) with three months of limited email follow-up. Weight loss was significant within the ACT group at every follow-up time ($p < .05$). At the end of the 24-month study, the overall weight loss was greater in the ACT group (−7.18%) than in the SR group (−4.18%) and control group (−1.15%). However, comparing between ACT group and the SR group, and SR group and CG, the weight loss were not significant ($p > .05$). There was significant difference in weight loss between the ACT and CGs ($p < .05$) at 24 months (Similar results were revealed in weight-related difficulties. All three groups showed marked decreases, but no significant differences were noted.

In the study done by Palmeira et al. (2017), 73 overweight (mean BMI = 34.24 kg/m^2, SD = 5.04) female participants (aged 18 to 55, mean age = 42.35, SD = 8.79) joined a nutritional treatment for weight loss in primary care units and hospitals; they were randomly allocated to either Kg-Free (plus Treatment As Usual, TAU) (ACT group) or CG (TAU) (non-ACT group) by using a computer-based randomized distribution. Kg-Free was a manualized group intervention based on mindfulness, ACT, and compassion-based approaches. At week 12 post-intervention, the ACT group had a substantial

decrease in weight-related difficulties and weight (−1.99% in ACT vs. −0.1% in CG) in comparison to the CG. These results synchronized with the other outcomes measured in the study, which indicated that eating behavior, weight stigma, body composition measures, self-criticism, and self-compassion were also affected due to the intervention. However, there were no significant differences in terms of mindfulness between the ACT group and the CG, as both groups demonstrated an improvement in post-intervention measures.

Sairanen et al. (2017) recruited 149 overweight or obese women (aged 25 to 60 years, mean age = 49.5, *SD* = 7.4, mean BMI = 31.3 kg/m^2, *SD* = 2.9) who reported symptoms of perceived psychological stress. The participants were randomly assigned into the ACT F2F intervention group (n = 70), ACT mobile intervention group (n = 78), and the non-treatment CG (n = 71). The ACT F2F group intervention comprised six group sessions throughout eight weeks, with a 90-minute duration for every session. The participants in the ACT mobile intervention were provided with smartphones with a standalone mental health training software pre-installed. The participants practiced the ACT training module on their own, which contained similar ACT-based intervention programs as the F2F session for eight weeks. The CG received no interventions. The ACT F2F and the mobile ACT application's outcome measures were combined into one. The ACT groups showed a decrease in weight-related difficulties, regardless of the type of ACT intervention. The effect of the intervention on their weight revealed by the mediation analysis which was intervened by a reduction in weight-related difficulties. However, there was no significant improvement in general psychological flexibility and BMI post-intervention and between groups (−2.26% in ACT F2F vs. −1.6% in ACT mobile) (p > .05). This emphasizes the importance of assessing for specific psychological flexibility when evaluating the changes in relation to weight loss.

Afari et al. (2019) recruited 88 overweight or obese (mean BMI = 37.2 kg/m^2, *SD* = 7.0) male veterans (aged 18 to 75 years, mean age = 57.3, *SD* = 9.9) who completed the *MOVE!* weight management program. Participants were randomized to four two-hour weekly ACT sessions or a continued behavioral weight-loss (BWL) intervention. Both groups exhibited a decrease in weight-related difficulties. Thus, reductions in weight-related difficulty mean becoming more psychologically flexible or being able to perform value-based actions in the existence of undesirable thinking patterns, emotions, and physical sensations in relation to weight. There was also weight reduction in both groups until the three-month follow-up. However, they reverted to the baseline level during the six-month follow-up (−0.9% in ACT group vs. −1.36% in BWL group). Nevertheless, this study showed the promising potential of the *MOVE!* weight management program; further studies are needed to explore its effectiveness with regard to the maintenance of outcomes.

Lillis et al. (2017) recruited obese participants (mean BMI = 37.6 kg/m^2, *SD* = 5.35, male, n = 24 (14.8%); female, n = 138 (85.2%); aged 18 to 70 years (mean age = 50.25, *SD* = 11.0)) who had high internal disinhibition (N = 162). They were randomly assigned to either acceptance-based behavioral intervention (ACT +

traditional weight-loss strategies, $n = 81$) or standard behavioral treatment (non-ACT, $n = 81$). There were 32 intervention sessions in the span of one year. Weight-related difficulties decreased significantly in both groups; however, there were no significant differences between groups at the 6, 12, 18, and 24-month follow-ups ($p < .05$). Weight changes (−4.2% for ACT and −2.4% for non-ACT) appeared to be significantly correlated with decreased weight-related difficulties in both groups, during both intervention and post-intervention. In addition to that, other measured outcomes (eating behavior and weight control strategies) had no significant differences between the groups ($p > .05$), except for values-consistent behavior ($p < .05$). Compared to the non-ACT group, the ACT group demonstrated more value-consistent behavior. Since the ACT intervention includes values as a core process in the sessions, improvement in this variable in the ACT group confirms its effectiveness.

In the earlier study by Lillis et al. (2009), they included obese patients (mean BMI = 33.04 kg/m^2, $SD = 7.15$, male, $n = 8$; female, $n = 76$; aged above 18 (mean age = 50.25, $SD = 11.25$)) who had completed at least six months of any structured weight loss program in the past two years in US ($N = 84$). They were recruited from the local weight loss clinic and through flyers and advertisements in the local newspapers. Participants ($n = 43$) who were randomly assigned to ACT underwent a one-day, six-hour ACT workshop. The CG ($n = 40$) received no intervention. Follow-up at three months revealed that weight-related difficulties and weight decreased significantly in the ACT group than CG ($p < .05$). Except for breath holding ($p > .05$), other measured outcomes (psychological stress, quality of life, weight-related stigma) showed significant differences between groups ($p < .05$). The mediation analysis indicated that improvements in weight-related flexibility and weight loss were mediated by ACT—weight-specific acceptance coping and psychological flexibility. This study demonstrated the potential of ACT for weight-related issues and weight loss among the obese.

Small to large effect sizes indicate promising outcomes for the efficacy of ACT in reducing weight-related difficulties. Four studies revealed a greater reduction in weight-related difficulties (improved weight-related flexibility) in the ACT group than the CG, except for two (Afari et al., 2019; Lillis et al., 2017). One study did not provide sufficient results to report the effect size (Lillis et al., 2021), however, no significant difference was discovered between the ACT and SR groups with a more remarkable decrease in weight-related difficulties than CG.

Weight loss, on the other hand, appeared greater in the latest studies that utilized a 1-day ACT workshop (Lillis et al., 2021), compared to the earliest study (Lillis et al., 2009). Weekly ACT sessions do show effectiveness in reducing weight, as proven by two studies (Lillis et al., 2017; Potts et al., 2022). It is advantageous to conduct a longer follow-up in order to establish the participants' weight maintenance; however, one study showed very low weight loss (Afari et al., 2019). As expected, two studies (Palmeira et al., 2017; Sairanen et al., 2017) found a promising weight loss after the intervention. The variety of ACT intervention doses could not really give effect to the

weight loss measure. Thus, we can conclude that, if ACT intervention is present, its promising effects are worth exploring.

Discussion

Generally, the findings support the need for studies to assess the effectiveness of ACT in reducing weight-related difficulties and BMI. The results for improving weight-related difficulties and weight with ACT are encouraging. Due to the limited number of studies and inconsistent outcomes, more studies are required to assess the effectiveness of ACT for weight-related difficulties and weight loss.

Based on the findings of this review, various intervention durations (a one-day of five to six-hour workshop, and multiple weekly sessions) and formats (F2F, online, phone calls, emails, and a self-help book) yielded comparable findings. Multiple methods were utilized to deliver ACT intervention to the participants. This denotes the flexibility of ACT therapists and researchers in the delivery of ACT intervention.

All studies reported a small to large effect on weight-related difficulties or BMI, revealing that there could be a dose–response relationship. The improvement in BMI at the post-intervention within-group should be acknowledged, even though only a few studies (three out of seven) did not show a statistically significant weight loss difference between the ACT group and the non-ACT group. This finding is consistent with a prior systematic review that focused on health behavioral changes, and revealed that only a small number of studies found that an acceptance- or mindfulness-based intervention resulted in significant weight loss (Roche et al., 2019). It is notable that the two studies in our evaluation with the longest follow-up found no significant difference in weight loss between the ACT group and the non-ACT group. This is congruent with a systematic review that found ACT intervention is effective for long-term weight loss in one-third of the studies reviewed (a total of 16 studies) (Iturbe et al., 2022).

It is noted that all studies included weight-related difficulties changes in ACT intervention. Only one study measured the general psychological flexibility as outcome measure, found not significantly improved at post-intervention in ACT group. This finding is in contrast with a previous review, which discovered that the majority (80%) of the studies reviewed showed evidence of ACT's success in fostering general psychological flexibility (Griffiths et al., 2018). Among the current studies, specific psychological flexibility has been shown to be more impacted by ACT intervention, demonstrating that trials including weight-related outcomes must assess weight-related flexibility as one of the outcome measures. The weight loss seen in the intervention groups in this study provides evidence that improvements in weight-related flexibility may be mediated.

The effectiveness of ACT in improving the weight-related flexibility of overweight and obese individuals, as well as other psychological well-being measures, is significant in all examined studies. The improvements were from small to large effect sizes. The approach in which the ACT intervention was implemented in these studies may have resulted in greater improvements in weight-related flexibility.

Limitations and Future Directions

Research on the effects of ACT on weight and weight-related issues is still in its infancy, with just a small sample of studies including seven eligible studies published in the past 13 years (from 2009 to 2022). This review highlights the need for more studies in this area. All of the studies reviewed here included a high proportion of adults, with a wide range of ages, and the majority of participants were females from Western nations. This precludes the results from being generalized to a larger group. Furthermore, female participation is common in weight reduction programs. As a result, outcomes are more generalizable to women, which justifies the enrolment of males in research and weight-reduction programs in general. Even though randomization was conducted in all studies, allocation concealment was not conducted. To avoid potential bias, future studies should include allocation sequence concealment and employ attention control when examining intervention effects.

However, the research findings do pave the way for further exploration of the effectiveness of ACT in improving weight loss efforts for overweight or obese population. Future studies are recommended to include participants of a smaller age range, younger adults, and the Asian population. Using Asians as the sample population can cater to the rising trend of obesity rates in Eastern countries. The effectiveness of ACT using contemporary and low cost methods (e.g., WhatsApp, closed online groups) and a detailed investigation of weight loss programs that include physical activities or exercises in ACT intervention is also worth studying.

Conclusion

To summarize, this systematic review explores the potential of ACT intervention in weight-related difficulties and high BMIs. Future studies should be conducted among various overweight or obese populations, and higher-quality randomized controlled trials need to be conducted to establish the effectiveness of ACTs in this domain.

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ORCID iDs

Patricia Pawa Pitil https://orcid.org/0000-0001-8562-5904
Siti Raudzah Ghazali https://orcid.org/0000-0002-2389-9456

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Author Biographies

Patricia Pawa Pitil is a PhD candidate at the Universiti Malaysia Sarawak, where she currently doing her thesis on a behavioral study focusing on the body weight issue. She currently serves as a sports science lecturer at Universiti Teknologi MARA, Sarawak, Malaysia.

Siti Raudzah Ghazali is the Clinical Psychology Professor of the Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak. She holds a Master's of Science in Clinical Psychology from Eastern Michigan University and a PhD in Clinical Psychology from the Union Institute and University, Cincinnati Ohio. Her research work focuses on psychological trauma, PTSD, and mental health issues related to teenagers and higher education students. She previously served as a Senior Director of Centre for Student Development, Universiti Malaysia Sarawak. Currently, she serves as a clinical psychologist consultant for Malaysia Oil and Gas company, Petronas Sdn Bhd.

Appendix 14: Publication 5-Accepted for publication-March 2023 (Book title: Advancing Sports and Exercise via Innovation, Proceedings of the 9th Asian South Pacific Association of Sport Psychology. Publisher: Springer Link)

An Open Trial Targeting Weight-Related Psychological Difficulties among Young Adults with Overweight or Obesity During COVID-19 Lockdown

Patricia Pawa Pitil[1,2] [0000-0001-8562-5904] and Siti Raudzah Ghazali[1]
[1]Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia
[2] Faculty of Sports Science and Recreation, Universiti Teknologi MARA Sarawak Branch, 94300 Kota Samarahan, Sarawak, Malaysia

patriciapawa@uitm.edu.my

Abstract. Weight-related psychological difficulties (WRD) are associated with overweight and obesity including among young adults. We developed a program called ACT-EX (Acceptance and Commitment Therapy with Exercise), which incorporates six processes to increase weight-related psychological flexibility; acceptance, cognitive defusion, being present, self-as-context, values, and committed action for young adults who are overweight or obese (OW/OB). This open trial evaluated the feasibility, acceptability, and efficacy of the ACT-EX program. Fifty young adults who were OW/OB (78% female, 22% male; mean age = 21.32 years (SD = 1.2); Body Mass Index (BMI) = 30.01 kg/m2 (SD = 4.63); 36% Malay, 28% Bumiputera Sarawak, 20% Chinese, Bumiputera Sabah and Indians, 4% each) participated in a 6-week intervention and 6-week follow-up study. The WRD was measured by the Acceptance and Action Questionnaire for Weight-Related Difficulties Revised-18 (AAQW-R18). The ACT-EX program was well accepted. Significant decreases were seen in WRD in the post intervention program and at the 6-week follow up time ($p < .05$) and BMI ($p < .05$). Participants who participated in the intervention program showed a significant weight loss. This trial provides preliminary evidence for the feasibility, acceptability, and efficacy of the ACT-EX program among young adults who are OW/OB. In conclusion, the ACT-EX showed beneficial effects on reducing WRD and improving BMI. A controlled and randomized trial are warranted to further examine the effectiveness of ACT intervention in behavioral and weight management.

Keywords: Acceptance and Commitment Therapy, Exercise, Overweight, Obese, Young Adults.

1 Introduction

World Health Organization (WHO) reported that the prevalence of obesity is increasing every year, and it is the ten most common health problem in the world. The body weight category is determined by the body mass index (BMI), which is computed by dividing a person's weight in kilogrammes by the square of their height in metres (kg/m^2). For the Asian cut-off point, overweight is ranges between $23.0kg/m^2$ to $27.4kg/m^2$, and obesity is from $27.5kg/m^2$ to $34.9kg/m^2$ [1]. Despite various intervention programs in terms of health intervention of diet and exercise, the trend seems not to be decreasing.

Being obese, the person is susceptible to physical risks such as orthopedic injuries, cardiovascular disease, metabolic disease, and psychological risks [2, 3].

University students, who are young adults, underwent significant adjustments when they transitioned from high school to a more self-disciplined, independent, and learning-focused environment [4]. During those years, they undergo phases where peer acceptance and the tendency to behave according to the environment and society are important in this early adulthood phase. Most of the youth population is represented by university students aged from 18 years old to their mid-twenties. University students must adjust to new academic and social interests, as well as physical and mental changes that occur with the transition to living on their own, in order to be prepared for a future career. These new experiences might sometimes have an impact on their physical and psychological well-being. It is reported that 38.5% of university students in Malaysia are overweight and obese [5]. Recently, the prevalence rate of overweight and obesity was 22.19% and 16.88%, respectively [6]. This accounts for at least 4 out of 10 university students being overweight or obese, which is worrying.

As most exercise professionals claim that exercise and a healthy diet would tackle the obesity epidemic problem, the trend keeps rising yearly. Despite current exercise trends such as intense training, group exercise, and modified eating behavior, the alarm could not be denied every year. Therefore, it might be the best time to focus on the psychological side of this population, which may involve evaluating their behavior in relation to body weight. The key to losing weight is these three components combination: good nutrition, physical activity, and behavior modification. One promising behavioural intervention in weight management is the Acceptance and Commitment Therapy (ACT).

ACT is a cognitive behavioral approach to target avoidance of individuals when experiencing difficult thoughts and feelings [7]. It is a third-generation cognitive-behavioural approach that employs acceptance and mindfulness processes, commitment, and behaviour change processes to develop psychological flexibility by defusing unpleasant thoughts and accepting difficult emotions while sustaining values-based action [8]. This therapy includes six psychological processes: acceptance, defusion, self-as-context contact with the present moment, values, and committed action [7]. ACT might effectively reduce weight self-stigma and impact health-related behaviors in overweight and obese individuals. It is a promising acceptance-based intervention to manage those with overweight or obese.

Although most studies in Malaysia have identified the causes of obesity, it has been limited to mostly on epidemiological analyses; consequently, there is a gap in the research. The intervention involving a psychological approach to weight loss is still in infancy in Malaysia, even though this type of treatment is widely accepted elsewhere [9, 10]. Weight loss is evidenced by the influence of a high level of physical activity [11]. However, the exercise intervention combined with behavioral treatment is yet to be explored. To address this gap, we developed a programme called ACT-EX

(Acceptance and Commitment Therapy with Exercise), which incorporates six processes to improve WRD; acceptance, cognitive defusion, being present, self-as-context, values and committed action for young adults who are overweight or obese (OW/OB). This open trial assessed the feasibility and preliminary efficacy of the ACT-EX programme on WRD and BMI outcomes among university students who are OW/OB. We hypothesised that participants would improve on WRD as the primary outcome as well as the BMI. We also hypothesised the programme would be feasible as indicated by low or zero attrition and adherence to the intervention components.

2 Methods

2.1 Participants

During the COVID-19 lockdown, participants were recruited from two public universities in Kota Samarahan, Sarawak, Malaysia, using a purposive sampling technique. The advertisement was posted online between January and March 2021. This is a non-probability sampling method in which the target population is chosen based on the purpose of the study, with the hope that each participant will give the study unique and useful information [12]. The inclusion criteria of a participant included: a) person with BMI category of overweight to obese (overweight = 23.0–27.4 kg/m^2, obese = ≥27.5 kg/m^2); b) does not have any chronic disease (hypertension, diabetes) or orthopaedic injury; c) has good access to the internet for full videoconference sessions for intervention. The exclusion criteria of a participant included: a) a person who is currently on medication and has chronic disease history; b) orthopaedic injury patient; c) currently participating in a supervised exercise programme. Fifty participants with the inclusion and exclusion criteria were invited to participate in the study (see Table 1).

Table 1. Characteristics of the participants.

Demographics	**Mean (SD)**
BMI	30.01 (4.63)
Age	21.32 (1.20)
Sex	*n* (%)
Male	11 (22)
Female	39 (78)
Race	*n* (%)
Malay	18 (36)
Bumiputera Sarawak	14 (28)

Bumiputera Sabah	4 (8)
Chinese	10 (20)
Indian	4 (8)
Study level	*n* (%)
Diploma	3 (6)
Bachelor degree	47 (94)

2.2 Measures

2.2.1 Anthropometry

The participants' self-reported body weight and height were gathered. For weight classification, a young individual's self-reported body weight and height can be used to figure out their BMI [13-15]. Thus, the gathered data were considered reliable for analysis in this study. The weight and height of the participants were recorded to the closest kilogramme (kg) and centimetre, respectively. This section included instructions on how to self-weight with bathroom scales at home, which should be used for bodyweight records whenever possible. BMI was calculated by dividing weight in kilogrammes (kg) by height in metres (m^2), i.e., BMI = weight (kg) / height^2 (m^2). BMI cutoff values in the current study were 18.5 kg/m^2 (underweight), 18.5 - 22.9 kg/m2 (normal weight), 23.0 - 27.4 kg/m^2 (overweight), and $\geq$ 27.5 kg/m^2 (obese) [1]. The participants who were in overweight or obese category were eligible to take part in the study.

2.2.2 Acceptance and Action Questionnaire for Weight-Related Difficulties Revised – 18 (AAQW-R18) [16]

The AAQW-R18 is an 18-item self-report measure of WRD that examines weight-related thoughts, feelings, and physical sensations in relation to experiential avoidance. Items are rated on a 7-point scale (1 = "never true" or "not at all believable" and 7 = "always true" or "completely believable"). Higher scores reflect more weight-related experiential avoidance. There have been reports of good internal consistency, test-retest reliability, and validity [16]. Cronbach's alpha for the present study was 0.64, which is considered acceptable [17].

2.2.3 Demographic Characteristics

The demographic information included sex, age (in years), and study levels.

2.2.4 Design and Procedure

The study was an open trial of 50 participants who were allocated to ACT-EX program. To evaluate the feasibility and initial efficacy othe study, a single-group design was utilized. The intervention lasted 12 weeks. Groups met were weekly for ACT intervention, and 3 times per week for exercise intervention over 6 weeks. There was no intervention contact between week 6 the follow-up at week 12.

The research proposal was presented to the Medical Ethics Committees, Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak Research. The study protocol was executed following the ICH Good Clinical Practice Guidelines, Malaysia Good Clinical Practice Guidelines, and the Declaration of Helsinki (UNIMAS/NC-21.02/03-02 Jld.4 (02)). Participants who met inclusion criteria were provided the Physical Activity Readiness Questionnaire and consent form as they agreed to become participants. Before they sign the written consent form, they have informed about the study procedures and potential risks. The consent form described (i) the confidentiality and anonymity of their data, (ii) the purpose and procedure of the study, (iii) the decision to participate in the study, and (iv) the right to withdraw their data at any time. They complete the questionnaire, which includes self-reported weight and height, demographics, and the AAQW-18. Following the baseline assessment, participants attended a 6-week ACT-EX programme and underwent post-intervention and 6-week follow-up assessments. At the 12-week follow-up, participants were given a token of appreciation for their time and effort.

2.2.5 ACT-EX Programme Components

The ACT-EX programme was a virtual by using the video conferencing, group-based treatment. The participants attended the ACT sessions once a week for 1.5 hours each session for 6 weeks. This ACT was designed to promote psychological flexibility that encourages openness, awareness, and engagement. The content of the sessions was adapted from an ACT intervention that has been designed for the context of weight loss used in previously published studies [18, 19]. The key intervention components were (a) values, to increase motivation, (b) cognitive defusion, to disrupt the linkages between food-and-exercise-related thoughts and behaviour, and (c) acceptance, to help participants tolerate negative emotions (d) become more mindful, and (e) committed to weight loss-related values. Participants were allowed to take notes during the sessions and were given the theoretical component of the ACT model. At the end of the sessions, homework tasks were also included. In order to increase participation, the program's content addressed the participants' personally identified values (see Table 2 for the content of the ACT sessions).

The researcher supervised the exercise programme, which consisted of three virtual videoconference sessions each week for 6 weeks. A minimum of 24 hours between sessions was allocated to allow for recovery and to avoid injury. Each session consisted of 60 minutes of moderate-intensity exercise. The exercise guideline follows

the guideline based on the American College of Sports Medicine. A minimum of 150 minutes of moderate intensity per week was suggested for an overweight or obese population for weight loss [20]. A total body workout was implemented for all sessions. The intensity of exercise was between 65% to 85% of maximum heart rate (HRmax) or Rate of Perceived Exertion (RPE) of 12 – fairly light to 15 – hard [21].

The percentage of HR maximum was utilised to calculate the target HR. Specifically, HRmax is equaled to 220 minus age. The study participants' age ranged from 18 to 25 years old, thus their HRmax was between 195bpm and 202 bpm. The target HR was determined by the percentage of exercise intensity multiplied by 220 minus age. Table 3 shows the target HR by age and the percentage of the exercise intensity.

During each workout, the participants were instructed to assess their HR using a smartwatch or their RPE based on the Borg scale. The exercises consisted of bodyweight exercises targeting the large muscle groups (e.g., push-ups, squats, lunges, crunches). A warm-up and cooling down were executed during the beginning and at the end of each session. The intervention was well-attended, with 100% attendance. The feasibility of the virtual videoconference and group-based treatment contributed to this success.

Table 2. Content of ACT sessions.

Session/component	**Aims**	**Key metaphors and exercises**	**Application to weight loss**
1 Values	-To identify personal values. -To evaluate if weight reduction would support such values	The choice point. Values assessment rating.	Enhance motivation to lose weight
2 Cognitive defusion	-To learn to detach themselves from stressful thoughts concerning bodyweight and to increase their commitment to health-related values.	Push papers	- To be aware of when one's thoughts may jeopardise one's efforts to eat healthily and exercise. -To aid in dissolving the connection

			between diet and food-related thoughts and actions.
3 Acceptance/willingness	- To improve willingness to tolerate adverse internal states, the distress associated with physical exercise (e.g., weariness, physical discomfort, impulses to stop) and diet-related feelings (e.g., cravings)	Breathing exercise	To assist participants in coping with negative emotions (physical activity and diet-related feelings) rather than relying only on control or avoidance strategies.
4 Mindfulness	-To build a sense of self that enables the free flow of thoughts and emotions. -To enable the individual to maintain a nonjudgmental relationship with psychological and environmental phenomena as they occur.	Observational self-exercise. Be where you are exercise	To aid defusion and acceptance strategies.
5 Committed action	-To set goals aligned with the participant's values. -To become aware of the necessity of	Goals, barriers and action exercise. Living in accordance	-To help the participant set and achieve weight loss goals. -To facilitate long-term adherence to

	adhering to values. .	with values exercise.	weight loss/maintenance strategies.
6 Review	- Reviewing the participants' experiences over the previous weeks and assisting them in handling any concerns that may have occurred. -To remind participants of key concept	Question and answer session. Selection of exercises and metaphors from previous sessions.	Same as before.

Table 3. Target HR based on age and exercise intensity.

Age	**HRmax (220 – age)**	**65% of HRmax Target HR (bpm) [% x (220 – age)]**	**85% of HRmax**
18	202	131	172
19	201	131	172
20	200	130	170
21	199	129	169
22	198	129	168
23	197	128	167
24	196	127	167
25	195	127	166

Note. HRmax: Heart rate maximum, Bpm: Beat per minute

2.2.6 Statistical Analysis

IBM SPSS Statistics version 26 was used to analyse the data. For demographics and outcome variables, descriptive statistics (frequency, percentages, means, and standard deviation) were presented. Repeated measure analysis of variance was used to investigate changes in outcome measures; WRD and BMI over time (baseline to post-intervention and baseline to week-12 follow-up). Cohen's *d* was calculated from baseline to post-intervention (week 6), baseline to follow-up (week 12) to compute effect sizes using the estimated values. A within-group effect size of 0.5, 0.8, and 1.1 was considered small, moderate, and large respectively [22]. All analyses were set at a significant level of 0.05 ($p < .05$).

3 Results

The participants reported significant decreases in WRD (Wilks' Lambda = 0.155, F = 131.11, p = 0.001, np^2 = .86) post intervention and at the 6-weeks follow up. The BMI also decreased over the 12-week of the study (Wilks' Lambda = 0.371. F = 37.44, p = .001, np^2 = 0.63), although it was not significant at the post-intervention ($p > .05$). The significant decreased was observed at baseline to follow-up ($p < .05$) (see Table 4). Analysis also showed that the participants continued decreased in WRD (see Figure 1) and lose weight (see Figure 2) after the program.

Table 4. Analyses from baseline to post-intervention and baseline to week-12 follow-up on study outcome measures (N = 50)

	Observed Mean (SD)			**Change from baseline to post-intervention**			**Change baseline to week-12 follow-up**		
	Baseline	Week 6 - post-intervention	Week-12 follow-up	Mean difference (95% CI)	Effect size	*p*	Mean difference (95% CI)	Effect size	*p*
WRD	80.96 (10.69)	57.66 (7.25)	53.46 (9.11)	23.20 (18.93, 27.67)	2.18	.001*	27.50 (23.31, 31.69)	2.57	.001*
BMI	30.01 (4.63)	28.38 (5.36)	27.69 (4.71)	1.63 (-0.504, 4.074)	0.35	.177	2.32 (1.66, 2.98)	0.50	.001*

Note. WRD: weight-related difficulties; BMI: Body mass index
*Significant at .05 ($p < .05$)

4 Discussion

The purpose of this study was to evaluate the effectiveness of ACT combined with structured exercise programme (ACT-EX) in improving WRD and BMI among university students who were overweight or obese during COVID-19 lockdown. As far as we are aware, the present study is the first attempt to include structured exercise program in ACT-based intervention designed exclusively for weight loss in our country. The ACT-EX programme provided therapy that addressed six major psychological processes: acceptance, defusion, self-as-context contact with the present moment, values, and committed action for psychological flexibility and weight control, plus the 3 sessions per week for 6 weeks of structured exercise programme. Results showed that the ACT-EX program in this study could be a promising intervention for weight loss among OW/OB young adults.

There was zero attrition rate throughout the 12-week duration, from the baseline to post-intervention at the sixth week to the follow-up at week 12. This rate proves the feasibility of the video conferencing method in delivering the intervention. Due to the limitation of movement caused by COVID-19, the online therapy and exercise intervention via video conferencing made the participants commit to the intervention. This result should be highlighted as successful as physical sessions, be it psychological therapy or exercise sessions.

This study suggests the effectiveness of ACT-EX in reducing WRD among the OW/OB participants. The intervention effect was large both baseline to post-intervention and baseline to follow-up. The mean plot confirmed this finding (see Figure 1). The evidence-based for the ACT as an effective treatment for WRD was also found in the previous studies [23, 24]. However, this study is the first one that includes structured exercise in ACT intervention. We speculate that the exercise component might have contributed to the significant finding. Exercise promotes pleasant effects, such as improved self-esteem and body image [25], influencing the ACT's effectiveness in reducing experiential avoidance related to their weight. This indicates that successful intervention to reduce WRD for OW/OB university students was with ACT and the element of exercise.

The WRD was further improved even though the interventions have ended, indicating that the participants were more likely to practice what they had learned during the intervention. They may have continued the exercise by themselves with the ACT knowledge they obtained, thus making them more psychologically flexible. The exercise intervention may become a habit among the participants, where they underwent three sessions of moderate-intensity exercise for 6 weeks. Consistently exercising may facilitate more frequent exercise via habit formation [26], improving the participants' weight-related psychological flexibility.

Despite the fact that this was an open trial, the results are encouraging, since the participants reported experiencing weight loss after the intervention (5.9%) and the

follow-up (1.83%). The intervention effect was very small from baseline to post-intervention but increased from baseline to follow-up in small magnitude. The trend can be seen in the means plot for the changes from baseline to follow-up (see Figure 2). This finding suggests that the ACT-EX was effective in reducing BMI. The regular exercise sessions per week contributed to the weight loss. It is advisable to engage in moderate-intensity exercises for at least three days per week of accumulation of 150 minutes, which was achieved in this study. Following this guideline would bring health benefits [20]. As found in this study, it is known that exercise intervention could promote weight loss and improve BMI [27, 28]. The post-intervention to follow-up reduction of BMI shows that exercise did affect the sustainability of weight loss. The BMI was reduced by 7.7% from baseline to follow-up. When the program ended, the weight loss program aimed to ensure the participants kept improving their BMI even in a small gradual reduction. It is always challenging to see participants keep attaining their weight loss after a program ends [29], which would likely be achieved in this study. Even though the follow-up lasted for 12 weeks, which was equivalent to three months, the gradual decrease in BMI is sustainable. This finding suggests that the participants have the potential to continue to lose weight over time. Therefore, the structured exercise integrated with ACT benefits BMI improvement among the OW/OB participants and could benefit them in the long run.

In the context of weight loss, ACT promotes that healthy behaviours be aligned with firmly held personal values and commitment to them, which serve as an anchor when confronted with difficult situations and boost motivation to keep behaving healthily [30, 31]. The introduction of structured exercises in the ACT intervention improves weight management. The participants in this study were likely to continue their exercise routine after regularly engaging in three sessions per week for a 6-week intervention. The ACT was held once a week during the 6-week intervention. The exercise may become a routine and can be practiced even after the intervention ends. Consequently, weight loss was assisted with the maintenance of physical exercises. ACT intervention has appeared to promote short-term increases in physical activity [18] and was also seemed possible in this study.

The ACT intervention taught the acceptance element to increase willingness to experience aversive internal states, the distress associated with physical activity. By doing the breathing exercise, physical discomfort, weariness, and other unpleasant feelings that occur during exercise were alleviated. This was to help the participants increase their tolerance towards the discomfort during the exercise. By increasing the tolerance, the dropout toward physical exercise is lessening. Fatigue experience from exercise sessions has been reported as one of the dropout reasons in physical activity among university students [32]. The present study has proven zero dropouts in the 6-week structured exercise intervention, again showing that they had increased their psychological flexibility.

This is the first study to integrate ACT with a structured exercise programme to treat overweight and obese young adults. This ACT-EX program demonstrated

feasibility and efficacy in decreasing WRD and BMI. This study also demonstrated the acceptability of videoconferencing method of delivering the ACT intervention and exercise sessions. However, some limitations need to be noted. Most importantly, this study did not include a control group, and we cannot conclude the model compared to a control group of young adults in the overweight and obesity category. The study relied on self-report body weight and height measurement for the BMI. These variables are likely to be biased in a self-report format, and future studies may improvise using proper equipment (e.g., weighing scale and stadiometer) for more precise measurement. This sample was inclusive of racial diversity, which involved the majority of races in Malaysia, but predominantly female, which might limit the generalizability of our findings.

5 Conclusions and Future Study

ACT-EX is the first programme that integrates a structured exercise program in ACT intervention for overweight and obese young adults, especially university students. This open trial contributes to the expanding body of research demonstrating that ACT-EX is highly acceptable and offers encouraging data regarding WRD and weight loss. More studies are needed to examine the variables associated with the overweight and obese population. More research is needed to evaluate whether the ACT-EX program can effectively treat WRD and weight management, how it can be integrated into an exercise in a weight loss programme and whether doing so improves long-term outcomes for overweight and obese individuals. Future research should compare the ACT-EX to a control condition with a longer follow-up period, as this could result in a sustainable effect on WRD and weight loss.

Acknowledgment

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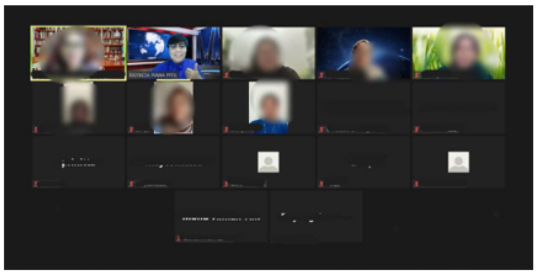
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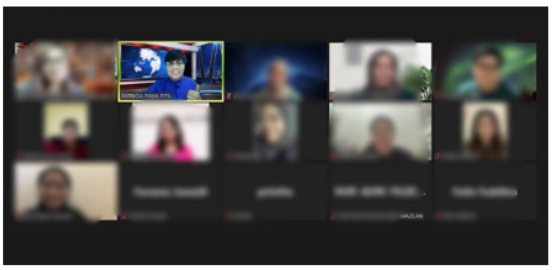
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Appendix 17 Proof of Participants' Attendance to the Sessions

Attendance for ACT Group

Participant	Session 1 – Date 9/3/2021	Time in	Session 2 – Date 16/3/2021	Time in	Session 3- Date 23/3/2021	Time in	Session 4 – Date 30/3/2021	Time in	Session 4 – Date 6/4/2021	Time in	Session 4 – Date 13/4/2021	Time in	Baseline (Week 0)	Post (week6)	FU (week 12)
1	/	6pm	/	630pm	/	6pm	/	6pm	/	6pm	/	6pm	/	/	/
2	/	6pm	/	630pm	/	6pm	/	6pm	/	6pm	/	6pm	/	/	/
3	/	6pm	/	630pm	/	6pm	/	6pm	/	6pm	/	6pm	/	/	/
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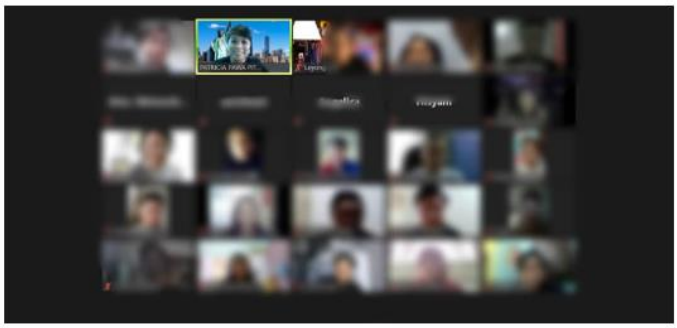




Attendance for ACT-EX Group (6 ACT, 18 EX)

ACT sessions

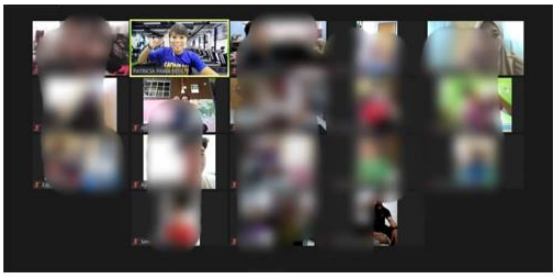
Participant	Session 1 – Date 19/4/2021	Time in	Session 2 – Date 26/4/2021	Time in	Session 3- Date 3/5/2021	Time in	Session 4 – Date 10/5/2021	Time in	Session 4 – Date 17/5/2021	Time in	Session 4 – Date 24/5/2021	Time in	Baseline (Week 0) 17/4/2021	Post (week6) 27/5/2021	FU (week 12) 10/7/2021
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2	/	6pm	/	630pm	/	6pm	/	6pm	/	6pm	/	6pm	/	/	/
3	/	6pm	/	630pm	/	6pm	/	6pm	/	6pm	/	6pm	/	/	/
4	/	6pm	/	630pm	/	6pm	/	6pm	/	6pm	/	6pm	/	/	/
5	/	6pm	/	630pm	/	6pm	/	6pm	/	6pm	/	6pm	/	/	/
6	/	6pm	/	630pm	/	6pm	/	6pm	/	6pm	/	6pm	/	/	/
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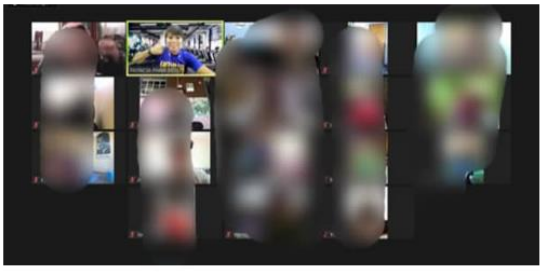


Exercise sessions (18 sessions)

Participant	S1 20/4/2021	S2 22/4/2021	S3 25/4/2021	S4 27/4/2021	S5 29/4/2021	S6 1/5/2021	S7 4/5/2021	S8 6/5/2021	S9 8/5/2021	S10 11/5/2021	S11 13/5/2021	S12 15/5/2021	S13 18/5/2021	S14 20/5/2021	S15 22/5/2021	S16 25/5/2021	S17 27/5/2021	S18 29/5/2021	Baseline (Week 0) 17/4/2021	Post (week6) 30/5/2021	FU (week 12) 12/7/2021
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- There was a minimum of 24 hours of recovery between sessions and not more than 72 hours between sessions.
- The exercise sessions were conducted on Monday, Wednesday, and Saturday at 7 pm.





Control Group

Participant	Baseline (Week 0) 20/4/2021	Post (week 6) 30/5/2021	Follow-up (week 12) 13/7/2021
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Appendix 18 Proof of Fat Loss Coach



FEA™
Fitness Edutraining Asia

Cert No: FLC/KL/2018/12/27

CERTIFICATE OF COMPLETION

Patricia Pawa Pitil
PARTICIPANT NAME

FAT LOSS COACH
COURSE TITLE

15th – 16th DEC 2018
DATE OF COURSE

ACE APPROVED CEP130638 CEC 1.2
ACE- APPROVED COURSE NUMBER & CEC AWARDED

FITNESS INNOVATIONS MALAYSIA - FITM
COURSE LOCATION

YEOH EE LING
EDUTRAINER NAME AND SIGNATURE

FITNESS INNOVATIONS MALAYSIA - FITM
COURSE PROVIDER NAME