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Narrative review of pedagogical interventions on nutrition knowledge and weight prejudice

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Abstract: *Objectives*: To synthesize and review pedagogically informed interventions that increase nutrition knowledge and decrease weight prejudice among practicing and pre-service health and education professionals. These factors have been addressed as separate entities in intervention-based research and this represents a gap in current literature. The overall aim of the paper is to make a recommendation for an intervention design that improves nutrition knowledge and weight prejudice amongst health and education professionals by tackling them simultaneously. *Methods*: Pedagogically informed intervention studies conducted between 1980 and 2016 which met three strict inclusion criteria were critically evaluated. These criteria included an appropriate sample size to match study methodology, a constructively aligned and clearly stated research methodology and the use of a pedagogically informed intervention. The choice of theoretical framework of each study was assessed, along with outcomes of the studies. *Results*: A total of 22 studies met the inclusion criteria and were analysed. The use of pedagogy to inform intervention design was successful amongst interventions to improve nutrition knowledge. Addressing weight prejudice was semi-successful with the possibility of unintentional increases to prejudice possible with exposure to intervention content. *Conclusions*: Based on the studies in this review, interventions designed to achieve attitudinal change appear to be most likely to succeed if they are implemented using a combination of approaches that evoke empathy for overweight and obese individuals,

ABOUT THE AUTHOR

Thea Werkhoven is a qualified dietitian who has been working and researching at the University of Sydney in nutritional education for the past six years. Her research has focused on nutritional knowledge, weight-based attitudes and awareness of obesity amongst pre-service professionals. Specifically, Thea has undertaken a systematic review of the literature informing pedagogical interventions in increasing nutrition knowledge, weight bias and obesity awareness and used this information to design, develop and implement a large scale pedagogically sound Unit of Study available to undergraduate students across The University. Thea has also methodically evaluated and evolved the Unit based on research findings.

PUBLIC INTEREST STATEMENT

The purpose of this paper was to review intervention studies conducted amongst practicing and pre-service teachers and health professionals which aimed to decrease weight bias and increase general nutrition knowledge. To date, these factors have not been targeted simultaneously by an intervention and are known to be linked to the treatment and education of obese youth. Findings revealed that general nutrition knowledge is best increased using a tailored and pedagogically informed approach. However, weight bias was found to be more difficult to modify, needing a combination of approaches in order to be successfully decreased. Professionals involved in providing health education to overweight or obese individuals will benefit from reading this paper as it provides a summary of existing literature.

explain alternate causes for obesity external to diet and exercise, create discourse regarding socio-cultural norms regarding obesity and promote self-reflection to attenuate fat phobic attitudes.

Subjects: Physical Education Studies; Further & Higher Education; Teacher Education & Training; Techniques & Interventions - Psychosocial & Behavioural Issues; Higher Education; Physical Education; Teachers & Teacher Education; Allied Health

Keywords: education; nutrition; intervention; obesity; nutrition knowledge; weight prejudice; pedagogy; higher education

1. Introduction

1.1. Prevalence of obesity

The World Health Organization (WHO) defines obesity as a state of adiposity where an individual has excessive fat accumulation that may pose risks to health (World Health Organization, 2014). WHO statistics reveal that global rates of obesity have grown steadily over the last 20 years, doubling in prevalence whereby more than a third of the adult population were classified as overweight and further that 500 million individuals were classified as obese in the year 2008 (World Health Organization, 2014). Similarly high rates of obesity were observed amongst the global youth population under the age of five years, where in 2011 there were five million children who were classified as obese (World Health Organization, 2014).

As a prominent health issue, the prevalence of obesity is continuously monitored and subsequently the global rates have remained high enough that is has ongoing classification as an epidemic to public health (Malik, Willett, & Hu, 2013). Health risks associated with being obese include atrial fibrillation, elevated levels of blood pressure, cholesterol and lipids and developing type two diabetes, metabolic syndrome, cardiomyopathy, coronary heart disease and some cancers (Zalesin, Franklin, Miller, Peterson, & McCullough, 2011).

Characterized by a body mass index (BMI) greater than 30 kg/m^2, individuals whose BMI exceeds this are considered to be at higher risk of developing comorbidities associated with excess adiposity (Australian Bureau of Statistics, 2012) and also to have a shorter life expectancy than that of peers with a normal BMI (Guh et al., 2009; Katzmarzyk, Mire, & Bouchard, 2012; Romero-Corral et al., 2006). Of greatest concern is the increased risk of mortality due to these comorbidities and the potential for an individual's ability to manage chronic diseases to decline when they are overweight or obese (Australian Institute of Health & Welfare, 2011).

As a result of the high global rates of overweight and obesity, strategies that aim to prevent further incidence of the conditions and treat those afflicted remain high priority in order to improve the burden of the diseases (Malik et al., 2013). Of interest to this review are strategies that target the prevalence of paediatric obesity, conducted by professionals responsible for nutrition counselling and health education to their clients or students. Professions that include aspects of nutrition counselling and the provision of health advice include dietitians, doctors, nurses, physiotherapists, exercise physiologists and school teachers. Amongst these professions, not only is knowledge of health and nutrition found to be important to professional practice but also attitudes held towards overweight and obesity amongst their clients or students.

1.2. Societal views towards obesity

When an overweight or obese individual is made to feel judged (Rukavina & Li, 2008) or victimized (Puhl & Latner, 2008) based upon their weight or appearance, this is known as weight based-stigmatization (Puhl & King, 2013). It occurs amongst adults and children and often individuals are left feeling socially unacceptable or insignificant when they are subjected to negative weight-based attitudes (O'Brien, Latner, Ebneter, & Hunter, 2012). Antifat attitudes are another way that

weight-based stigmatization is reported and includes the perception that an obese individual is lazier, sloppier in appearance, lacking self-discipline or willpower (Puhl & Brownell, 2001) and is unmotivated and incompetent than their normal weight counterparts (Puhl & Heuer, 2009). Obese individuals often experience weight stigma on a daily basis, most affected by attitudes directed at them by strangers than those perceived amongst spouses, parents, the media and their friends (Vartanian, Pinkus, & Smyth, 2014). Strangers include professionals who work in health care settings and are responsible for supporting the health and well-being of obese individuals (Puhl & King, 2013) including dietitians (Edelstein, Silva, & Mancini, 2009; Swift, Hanlon, El-Redy, Puhl, & Glazebrook, 2013), physiotherapists (Setchell, Watson, Jones, Gard, & Briffa, 2014), doctors, nurses, nutritionists [17] and obesity specialists (Tomiyama et al., 2015). Not only are practicing health professionals affected by weight stigma but pre-service health students are known to possess weight bias as well (Miller et al., 2013; Phelan et al., 2014; Puhl, Luedicke, & Grilo, 2014; Robinson, Ball, & Leveritt, 2014).

Closely associated to antifat attitudes are perceptions of health, where environments that equate higher levels of health with maintaining a thin physique are likely to foster antifat attitudes that follow conventional views of obesity prevention and treatment. This phenomenon is known as healthism (Brady, Gingras, & Aphramor, 2013). Healthism is perpetuated by societal views of obesity and obese individuals who are portrayed unattractive, unhealthy and unnatural and often medicalized and pathologized (Brady et al., 2013; Mansfield & Rich, 2013).

1.3. Educators' views of obesity

Educators of health and nutrition in schools have been identified as perpetrators of possessing antifat attitudes towards overweight or obese children under their instruction (Daníelsdóttir, O'Brien, & Ciao, 2010; Green & Reese, 2006) including professionals who promote Health and Physical Education (Greenleaf & Weiller, 2005). Often these educators fall prey to the social esteem held for achieving and maintaining a thin physique (Greenleaf, Martin, & Rhea, 2008) which puts them at risk of explicitly acting on their negative attitudes, falling prey to healthism. Common attitudes held by educational professionals towards overweight or obese children are that they are "weak willed, ugly, awkward (Young & Powell, 1985), gluttonous, stupid, worthless and lacking in self-control(Schwartz, Chambliss, Brownell, Blair, & Billington, 2003)", a bias that Walter, Ragan, Sulak, and Bagby (2013) suggest could be due to a lack of appropriate training. Physical education teachers who possess antifat attitudes are known to have lower expectations placed on overweight and obese children to perform physical tasks than those placed on normal weight children demonstrating biased attitudes towards their capabilities and motivation to complete tasks (Peterson, Puhl, & Luedicke, 2012). Physical educators with weight bias are also known to question the ability of obese children to play sports, their level of fitness and physical condition and perceived self-concept too (Peters & Jones, 2010). Often physical educators hold the belief that the weight of the child is within their own control or lack thereof (Chambliss, Finley, & Blair, 2004; Greenleaf & Weiller, 2005). Outside of physical expectations of overweight or obese students compared to their peers of normal weight, physical educators also have lower expectations for their social and cognitive functioning (Greenleaf & Weiller, 2005). Similar attitudes have been observed at the pre-service stage, held by future educators destined to be involved in the health and nutrition education of overweight and obese children (O'Brien, Puhl, Latner, Mir, & Hunter, 2010) such as pre-service educators undertaking exercise and nutrition related degrees (Chambliss et al., 2004). Implications of the possession of weight bias amongst educators and pre-service educators are for the health and well-being of overweight and obese children under affected educators, with possible negative outcomes for the children's psychological, social and physical health (Story, 1999).

1.4. Rationale and methodology of the review

With a the level of nutrition knowledge and weight-based attitudes possessed by practicing and pre-service health and education professionals already well established, this narrative review is concerned with interventions based studies to ameliorate these factors. This addresses the gap in the literature where nutrition knowledge and weight prejudice have been treated as separate targets of interventions aimed at health professionals. This style of review was conducted as it provides the

opportunity to interpret results in a holistic way, drawn on information from existing theories, promoting reflection and appreciation of the diversity of the topic of interest (Jones, 2004). Due to the limited nature of studies that matched the inclusion criteria, the decision was made to complete a narrative review instead of a systematic review or meta-analysis (Glass, 1976; Higgins & Green, 2008).

Aspects of the intervention studies that were selected as inclusion criteria included an appropriate sample size to match study methodology, a constructively aligned and clearly stated research methodology and the use of a pedagogically informed intervention. Interventions which adhered to these criteria were then pared down to those who used pedagogy as the basis for their intervention to increase nutrition knowledge or ameliorate weight prejudice. Studies included in the review were conducted between 1980 and 2016 and were published in peer reviewed academic journals available online. Search engines utilized included Medline, Cinahl and ERIC and search terms included nutrition intervention, nutrition programme, tertiary education, higher education, weight-based stigma, stigmatization and stigma reduction. Studies presented at conferences in poster presentations without available conference papers, studies that were not completed on similar groups of adults who were either employed in or studying to enter health-related professional roles were not included, as were studies that were not peer reviewed. Twenty-two studies conducted amongst tertiary level students or practicing health-related professionals as respondents were identified and met the inclusion criteria.

The following sections of the narrative review present the choice of theoretical frameworks used by each study and evaluate the methodology chosen to decrease bias and increase nutrition knowledge. Each aim is presented separately to mirror previous research, leading to recommendations on the most appropriate methodology for a pedagogical intervention amongst pre-service health and education professionals to achieve positive modifications to attitudes and knowledge simultaneously.

1.5. Intervention design; theoretical frameworks

A key factor in the success of attitude and knowledge amelioration interventions is the theoretical frameworks or approaches that they are based upon. Traditional viewpoints towards overweight and obesity often result in assumptions regarding the health status of an individual based on their appearance and promote the pursuit of thinness in order to achieve health (Robison, 2005). This is in stark contrast to alternative approaches to health that consider the societal and cultural influences on health (Cliff & Wright, 2010) such as Health At Every Size and Fitness not Fatness which take a more holistic approach to health (Gaesser, 2005). Key concepts to alternative views of health are the promotion of body acceptance, mindful eating behaviour and healthy lifestyle practices in the attainment of health, regardless of weight status and the shunning of traditional approaches to health including dieting and calorie restriction (Jenkinson & Benson, 2010).

One of the frameworks utilized in previous research aimed at increasing nutrition knowledge is the Constructivist Learning Theory (Fosnot, 1996) which is often used in settings that promote active learning and in pedagogical interventions. The theory was used in a study that sought to increase self-efficacy and readiness to teach health amongst practicing health educators in the USA who were responsible for nutrition and health education of middle school students (Fahlman, McCaughtry, Martin, & Shen, 2011). The same theory was also used amongst middle school students to improve their nutrition knowledge and behaviours (n = 1476) which became more positive after exposure to six nutrition lessons (McCaughtry, Fahlman, Martin, & Shen, 2011). Hence the framework has applications in both the youth population in need of health education and the educators responsible for delivering the health education as well.

Three main concepts of the constructivist learning theory were applicable to the nutrition content of the intervention. These were; Firstly, that active learning is favoured through discussion and activities rather than through rote learning and memorizing statistics and figures. Secondly, the theory

presumes that individuals possess basic knowledge of the applicable topic and that new information is retained in a contextually and accurate way (Fosnot, 1996). Thirdly, individuals are most likely to increase knowledge through social interactions in groups and share knowledge effectively when they are aware of the socio-cultural context in which it is applicable (Brooks & Brooks, 1999).

Participants of both studies that utilized the theory demonstrated that the interventions had been successful. At the conclusion of the intervention, the practicing teachers had higher levels of self-efficacy and expectations to be effective health educators (Fahlman et al., 2011). The middle school students who participated in the nutrition intervention and underwent the constructivist orientated education displayed improved nutrition practices and nutrition knowledge at its conclusion (McCaughtry et al., 2011). It is recommended that the Constructivist Learning Theory therefore has applications for opportunities of professional development for practicing educators and for integration into the curriculum and instruction of both educators and their student as well (McCaughtry et al., 2011).

A psychosocial theory often used in attitudinal change interventions is the Social Cognitive Theory, developed by Albert Bandura (1986). Its relevance is not limited to attitudinal change interventions and has a history of use in pedagogical interventions (Fahlman, Hall, & Gutuskey, 2013) and to increase nutrition knowledge in the higher education setting (Kicklighter, Koonce, Rosenbloom, & Commander, 2010). Social Cognitive Theory posits that knowledge acquisition occurs through the observation of other individuals' interactions and their experiences, helping to explain why people model behaviours based on their environment (Bandura, 1986). However, the use of the Social Cognitive Theory is not supported by all researchers for application in all situations. A meta regression analysis was completed by Greaves et al. (2011) into studies that had used the Social Cognitive Theory in planning interventions on obese people with the aim of achieving weightloss, improving diets and increasing levels of physical activity. Studies were compared on their use of theories such as the Social Cognitive Theory to plan interventions with health outcomes such as dietary and weight changes and there was only a medium association between outcomes and those that used theories to those that did not or did not explicitly state that they had (Greaves et al., 2011).

1.6. Intervention design; modifying antifat attitudes

A prior systematic review of 18 studies (Daníelsdóttir et al., 2010) conducted with the aim of reducing attitudes of weight stigma amongst in the youth, adolescent and adult population between the years of 1980 and 2009 extrapolated four main approaches utilized by researchers. These included:

(1) Attempting to change the perception that obesity is due to a lack of control,

(2) Building feelings of empathy, understanding and acceptance towards obese people,

(3) Challenging and transforming accepted societal attitudes towards obese people and

(4) A combination of these or multiple approaches in tandem (Daníelsdóttir et al., 2010).

Interventions that aim to modify perception of the controllability of obesity are often based on the Attribution Theory (Crandall, 1994; Crandall et al., 2001) whereby participants are guided through dissonance-based education in order to remove blame away from overweight or obese individuals regarding their weight status. When attacking beliefs regarding the controllability of obesity, numerous attitudes need to be addressed such as the belief that that fat people are lazy, lacks self-control, are responsible for their weight and deserve to be ridiculed (Swift et al., 2013). If this type of prejudice is detected and is strong it can lead to increased levels of weight bias and be extremely difficult to minimize or remove (Crandall & Reser, 2005).

Studies that have attempted to modify attitudes about the controllability of obesity have utilized a range of approaches to combat antifat attitudes. In order to take blame away from overweight or obese individuals for their weight, the most common technique used is that of creating discourse between what is perceived about the disease or obese individuals and other unknown or ignored

factors involved. For example, introducing the concepts of the aetiology of obesity excluding food and physical activity, the behavioural determinants involved in the disease and the importance of genetics (Diedrichs & Barlow, 2011). Limited success has been achieved through the use of education to increase awareness of the medical causes for obesity with only two studies achieving attitudinal change using this approach. The first known study that provided participants with the medical causes for obesity was completed in 1980 amongst 64 adolescent females and sought to investigate the level of antifat attitudes directed towards peers when overweight or obesity was explained by medical reasons by those afflicted (DeJong, 1980). Peers in this study were provided with profiles and photographs of obese and normal weight girls, some of which explained obesity to have been due to a medical condition such as a thyroid disorder and some without any explanation. The researchers found that providing a medical explanation resulted in an improvement in attitudes where obese subjects were viewed as less self indulgent and more self disciplined and were more well liked (DeJong, 1980). It must be noted that the subjects utilized in DeJong's study were paid to participate and almost all of participants were of normal weight range. This means that the results may not be typical of a cohort not paid to participate and that results may have been an over-representation of attitudes held by people within the normal weight range but not those who are underweight or overweight/obese.

A study conducted amongst a larger sample of 251 undergraduate students sought to investigate the attitudes and beliefs consistent with blaming overweight and obese individuals for their weight and to measure antifat attitudes (Crandall, 1994). The medical causes for obesity that were integrated into this study included an explanation of the genetic influence on weight and metabolic causes including the body's natural set point that helps to control the natural weight that an individual rests at despite weight loss or weight gain efforts. Utilizing these explanations resulted in a reduction in antifat attitudes, less reported explicit dislike of obese people and a reduction in the belief that obese people lack willpower (Crandall, 1994).

Unintended outcomes of studies that challenge perceptions of the controllability of obesity include increases in prejudice towards overweight and obese peers, observed amongst children (Bell & Morgan, 2000) or a failure to achieve attitudinal change (Anesbury & Tiggemann, 2000) or even increases in antifat attitudes at the conclusion of the intervention (Teachman, Gapinski, Brownell, Rawlins, & Jeyaram, 2003). It has been posited that individuals who attribute certain negative characteristics with fatness are likely to display increases in antifat attitudes when exposed to possible negative thoughts that they had not considered prior to exposure to the intervention (Daníelsdóttir et al., 2010). Caution is exercised in interpretation of results or application of recommended attitudinal modification techniques based on the methodology utilized. For example, the studies completed by DeJong (1980) and Bell and Morgan (2000) did not make use of an experimental research design and only collected measurements of attitudes at one time point. If no baseline level of antifat attitudes is established, any changes to attitudes cannot be linked definitively to an intervention. Instead, any modifications to attitudes may have been due to factors external to the intervention and those outside of the control of the researchers. Responses may have been biased, with participants likely to answer stigma-related questions in a socially desirable way that makes them appear less biased, especially if they are aware of their own prejudices (Daníelsdóttir et al., 2010).

Another technique adopted by intervention studies that aim to modify attitudes is to evoke empathy for overweight and obese individuals including the use of narratives from the perspective of the afflicted individual (Teachman et al., 2003), presented through visual media (Hennings, Hilbert, Thomas, Siegfried, & Rief, 2007) and personal recounts (Gapinski, Schwartz, & Brownell, 2006). The success of evoking empathy is mixed, with unintentional increases in antifat attitudes observed as a side effect of exposing participants to stigmatizing beliefs. An intervention study using a pre- and post-test design had a cohort of 602 adolescents watch a 20 min video of interviews held with obese adolescents that discussed personal stories of weight based discrimination and reasons for fatness. The intervention was successful in increasing understanding regarding difficulties caused by being obese as an adolescent however the level of prejudice towards obese individuals increased (Hennings

et al., 2007). The follow-up survey completed amongst the adolescents was conducted three months after the conclusion of the intervention and may explain why increases in antifat attitudes were observed. With a 12-week span between the intervention and the survey it is possible that external influences outside of the study were responsible for changes in attitudes and the lack of qualitative surveys to explore this make it impossible to determine the causal effect of the intervention on attitudes alone.

It has been hypothesized that basing a stigma reduction intervention on empathy may increase antifat attitudes or fail to be successful in reducing antifat attitudes because it feeds pre-existing prejudice that views obese people as fat, lazy, unhealthy and lacking self control (Daníelsdóttir et al., 2010). There are two types of prejudice that must be taken into account in all attitudinal change interventions; explicit and implicit bias. Implicit bias is often unconsciously held and often harder to modify as it is more ingrained and unrecognized (Greenwald & Banaji, 1995). Explicit bias is more overt and often results in direct discriminatory behaviour towards marginalized groups such as overweight or obese individuals (Walter et al., 2013). Reducing both explicit and implicit weight bias was tested in one study using a pre- and post-test experimental design amongst pre-service doctors and dietitians through the use of anti-stigma videos that aimed to dispel myths regarding the causes of obesity and increase awareness of the plight of obese individuals. Baseline and follow-up results six weeks later were compared between control (n = 21) and intervention (n = 22) groups and participants who viewed the videos displayed decreased levels of explicit bias, less likely to voice or display stigmatizing attitudes towards overweight or obese individuals after the intervention (Swift et al., 2013). Levels of implicit bias were not modified using this approach and this suggests that it may be harder to modify ingrained stigmatizing attitudes as participants are more likely to recognize the social impropriety of expressing an explicit bias at the time of surveying and answer questionnaire appropriately, maintaining their beliefs after being exposed to empathy evoking stimuli. Interpretations and recommendations from study are limited due to the small sample size and the specific groups of interest to the study, limiting the generalizability of results.

Associated to the attempt to evoke empathy for obese individuals is the act of challenging societal norms or beliefs in order to reduce prejudice. One study that made use of this technique tested the societal influence on shared opinions and beliefs amongst tertiary students (Puhl, Schwartz, & Brownell, 2005). Participants (n = 60) were undergraduate students enrolled in early degree psychology electives and were split into three experimental groups. Participants were provided with portrayals of theoretical obese individuals in either a positive or negative light and were required to place associations of character attributes with the theoretical individuals. The association between how the obese individual person had been framed and the resulting character attributes were then measured. If the obese person had been framed negatively, participants associated more negative than positive traits to them and when the information was framed positively by peers in the social group overall antifat prejudice decreased (Puhl et al., 2005). It must be noted however that although the results from this study suggest that challenging social norms is useful in decreasing weight bias, most of the sample was Caucasian in ethnicity and cross-cultural differences have been identified as an influence on antifat attitudes (Hebl & Heatherton, 1998).

Stigma reduction interventions are also seen to be influenced by the recruitment process employed in order to gather participants. Regardless of rigorous experimental design, if a study recruits volunteers with the preface of gaining knowledge, reducing negative attitudes or promotes self-improvement as an outcome of participating, it risks influencing the motivation for enrolment and potential outcomes of the study. This was observed in one study that was open to pre-service and practicing educators who were interested in learning about issues regarding obesity and diversity in the school setting. Of the 260 participants that volunteered for the study, the intervention group took part in a web-based programme that promoted size acceptance, in line with the study aims that were recognized before signing up for the study (Hague & White, 2005). This transparency regarding desired outcomes and methodology could possibly turn away potential study recruits who were not interested in learning about obesity or diversity. Also, participants who acknowledge their

own shortcomings related to study outcomes such as high levels of bias are unlikely to enrol in such a study, putting bias on results (Farley, 2000).

Alternate techniques to those listed above include the use of dissonance-based activities which focus on body image, making participants challenge their personal perception of the media's portrayal of fat bodies, the act of fat shaming and association of fatness with disability. This technique was used in one study in a community sample of 40 females and almost two thirds of participants displayed lesser levels of fat phobia at the conclusion of the intervention after their association of personal responsibility with fatness was challenged (Robinson, Bacon, & O'reilly, 1993). It is suggested that by creating dissonance around socially accepted attitudes towards obesity including association of fatness with fitness and attractiveness, modifications in attitudes can be achieved so that they are less negative (Ciao & Latner, 2011). Instruments that measure fat phobia are prone to issues with response bias and the creators of the Fat Phobia Scale note that better instruments need to be developed for general population use with application in differing ethnicities and between genders (Bacon, Scheltema, & Robinson, 2001).

Reduction of obesity-based prejudice in pre-service health professionals has been problematic, with some researchers labelling no particular method "effective" in modifying attitudes. (O'Brien et al., 2010). A randomized trial was conducted on 159 pre-service health professionals enrolled in a health promotion or public health bachelor's degree with random allocation to either an experimental or control group (O'Brien et al., 2010). The researchers aimed to test the effect of two strategies of obesity education on weight bias and taught two streams according to the modifiable (e.g. diet and exercise) and unmodifiable (e.g. genes and environment) determinants of obesity. Controllable reasons were presented as part of a normal obesity curriculum and uncontrollable reasons served as a prejudice reduction programme. Where the normal obesity curriculum resulted in an increase in implicit prejudice, the prejudice reduction programme significantly reduced explicit antifat prejudice (O'Brien et al., 2010). Thus, a traditional approach for teaching the causes of obesity in higher education courses has the ability to increase prejudice rather than decrease these attitudes. Alternately, the provision of alternative viewpoints that take blame away from obese individuals are not likely to modify deep seeded prejudice, rather only the expression of such attitudes.

1.7. Intervention design; increasing nutrition knowledge

Just as important to the quality of nutrition education and health counselling provided by health professionals is the level of nutrition knowledge that the health professionals possess. For health professionals to be effective in providing health instruction and satisfy curricular outcomes, they require nutrition training through the form of mandatory classes during their tertiary study which would support positive classroom practices (Rossiter, Glanville, Taylor, & Blum, 2007). A cohort of 103 Canadian pre-service general educators who were in their final year of study were surveyed in order to determine the influence of the students' knowledge, attitudes and eating behaviours on intended classroom food practices (Rossiter et al., 2007). At the end of their higher education the majority of the cohort was found to have mid to low levels of nutrition knowledge and two thirds displayed poor nutrition habits including having a diet high in fat. Students destined to teach in secondary rather than primary schools were more likely to use unhealthy classroom food practices such as using confectionary as rewards in class or allowing students to consume sugar laden drinks in class. Students with a high investment in personal health and those who did not value a healthy school environment were also likely to be poor health promotion agents (Rossiter et al., 2007). This lower level of nutrition knowledge was also detected amongst a sample of 72 pre-service health and physical educators who were surveyed in three consecutive years leading up to graduation (Werkhoven, Cotton, & Russell, 2014). Nutrition knowledge was lower towards the beginning of the education degree and increased when students enrolled in a nutrition elective in the end stages of their degree. Resulting recommendations from this study including the requirement for nutrition education to be mandatory during higher education, especially for health and physical educators. In this way, future educators including physical educators would be equipped with the knowledge and skills required to be effective at providing health and nutrition education once employed (Werkhoven

et al., 2014). Although nutrition education interventions have not followed a prescription, a commonality between them is the delivery method. Many have delivered the programmes through series of lectures and tutorials provided as formal courses or electives that have been tailored to suit the desired knowledge outcomes or setting.

Comparison of programmes designed to increase nutrition knowledge is problematic, as is the use of pre-existing nutrition content in new intervention programmes. This is due to the continual turnover of clinical information utilized in pedagogical interventions which must be updated each time new dietary guidelines are released or when nutrient information is updated. Also, each intervention is extremely relevant to the country in which it is developed, limiting its application in other nations due to the relevance of information including socio-cultural influences on designated content. Hence, it is more appropriate to compare the method of delivery and tools utilized in order to make content more clear and memorable between studies.

Promoting self-reflection and assessment has proven to be semi-successful when conducted using technology in the tertiary setting. Computerized dietary assessment software was trialed in one study amongst American tertiary students completing a course in personal health (Hensleigh, Eddy, Wang, Dennison, & Chaney, 2004). The design of this study was experimental and had an intervention group (n = 130) and a control group (n = 59). The control group completed didactic traditional lectures and tutorials and the experimental groups completed separate modules on health and well-being including eating well with a wider range of activities than that of the control group. Although the use of the software did not produce significant differences in nutrition knowledge, it was found to be effective in pushing students to constructively evaluate their own eating behaviours and make recommendations for positive changes in their future nutrition practices and food choices (Hensleigh et al., 2004).

Peer-to-peer instruction or a smaller age gap between students and teacher has been shown to increase success of nutrition-based interventions in tertiary students. As a concept, peer-to-peer education has been identified for use in classroom teaching amongst students (Pérez-Rodrigo & Aranceta, 2001) and when used in tertiary programmes was thought to have the potential to allow better interrelationships between students and teachers. To test this theory, a study was conducted amongst 34 mixed enrolment college students in the USA to test if peer instruction resulted in increased nutrition knowledge and changes to nutrition practices at the conclusion of the intervention (Kicklighter et al., 2010). The intervention was delivered by recent health graduates and at the conclusion of the intervention had higher levels of nutrition knowledge and reported practicing healthier eating behaviours (Kicklighter et al., 2010). Although this is promising, the use of recent graduates to conduct nutrition education within pedagogical interventions may come at cost, with lack of experience and confidence in conducting education a possible side effect. It is unknown how effective the graduates felt from the study as no survey was conducted amongst them to determine if they felt knowledgeable, effective and confident.

2. Conclusions

The design most likely to be successful amongst pre-service educators and health professionals appears to be one that uses a combination of approaches to tackle both level of knowledge and attitudes simultaneously. Previous research has identified the need for an intervention design that addresses weight based attitudes during higher education and in the workplace. A common issue with attitudinal based interventions is the likelihood of participants answering surveys with bias, providing socially acceptable answers to please the researchers. Also, there is the possibility that the level of bias may unintentionally be increased if participants are exposed to common negative weight-based attitudes. Modifying implicit or unconscious levels of prejudice is the most desirable goal of attitudinal interventions, however is the most difficult to achieve as a long lasting effect.

Interventions to achieve attitudinal change appear to be most likely to succeed if they are implemented using a combination of approaches in tandem. These include evoking empathy for

overweight and obese individuals, providing explanations for alternate causes of obesity external to diet and exercise, creating discourse regarding socio-cultural norms regarding obesity and promoting self-reflection to attenuate fat phobic attitudes. Modifying nutrition knowledge amongst pre-service professionals such as educators has a more positive history. The most successful nutrition pedagogical interventions have addressed principles of general nutrition knowledge specific to the country of interest, including food standards, dietary guidelines, the links between diet and disease and how to build positive nutrition practices for a healthy lifestyle. To date, no intervention has been conducted amongst pre-service educators that aim to modify both antifat attitudes and level of nutrition knowledge simultaneously. A direction identified by this review is the need for a pedagogical intervention to address antifat attitudes and nutrition knowledge, especially in the higher education setting. Future research in this area is recommended.

To increase the chance of accurate findings in studies that address both factors simultaneously, this recommended research needs to not only have a large sample size, but it should also include in-depth case studies and focus groups should be implemented in the research design in order to investigate the themes more fully. Further, study design should make use of a control and intervention group allowing for group comparisons to be made. With these recommendations, it is expected that intervention design would be explored in depth, allowing critical evaluation of its success and efficacy.

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