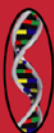


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NUTRITIONAL *and* PHYSICAL EDUCATION

JASON S. BUCHANAN
EDITOR



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NUTRITIONAL AND PHYSICAL EDUCATION

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NUTRITION AND DIET RESEARCH PROGRESS

NUTRITIONAL AND PHYSICAL EDUCATION

JASON S. BUCHANAN
EDITOR



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New York

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Preface

This new book presents current research in the study of nutritional and physical education. Topics discussed include nutritional education in the workplace; physical activity and obesity; nutritional game design by kids for kids; providing nutritional education to community-dwelling older persons, maternal nutritional education before and during pregnancy, and a discussion of the link between the endocrine system and obesity. (Imprint: Nova Biomedical Press)

Chapter I – Obesity is a major health problem [1, 2] and it is considered a chronic disease by the World Health Organization [3]. The definitions of overweight and obesity are based on body mass index [BMI], the bodyweight in kilograms divided by the squared length in meters. In adults, overweight is defined as a BMI of 25.0 to 29.9 kg/m², and obesity is defined as a BMI of 30.0 or higher. Obesity is further subdivided into grade 1 [$30 \leq \text{BMI} < 35$], grade 2 [$35 \leq \text{BMI} < 40$] and grade 3 [$\text{BMI} \geq 40$], the latter also referred to as morbid obesity [4, 5]. Both a reduction of food intake and an increase of physical activity are advantageous to reduce body weight.

In this chapter, the authors outline the pervasiveness and impact of the obesity epidemic and provide a summary of the common treatment of obesity and specifically of the role of physical activity as a treatment option. Furthermore, having outlined the influence of psychosocial factors in obesity treatment, an overview of possible physical exercise interventions will be given. Finally, the importance of motivation in physical exercise education in obesity and some practical tools will be offered.

Chapter II – The number of individuals in the United States and across the globe who are overweight or obese has reached epidemic proportions. The science and health care surrounding the study of obesity has expanded

significantly in the past 20 years. Researchers use animal and human investigations to describe biological processes associated with nutrition and the regulation of the body's intake, utilization, and storage of excess nutrient energy as fat. The endocrine system plays a major role in the regulatory mechanisms of energy supply and demand. Endocrine signals responsible for hunger and satiety such as leptin, adiponectin, and ghrelin are produced from adipose tissue and from the intestine. These signals are integrated in the hypothalamus and other areas of the central nervous system influencing eating behavior. The non-exercise energy thermogenesis (NEAT) required for routine daily living may play an important role in understanding obesity and the struggle for weight control. Obesity is the result of dysfunction of this complex, energy regulatory system. The mechanisms which evolved over thousands of years to assure a sufficient energy supply during times of famine and competition for a limited food supply, are now overwhelmed by the abundance of high energy, easily and inexpensively obtained food; marketplace pressures on eating such foods; and an ever increasing sedentary lifestyle decreasing energy utilization. The result is an epidemic of obesity and its attendant co-morbidities of cardiovascular disease, metabolic syndrome, diabetes mellitus, musculoskeletal disorders, and cancer which threaten to undo many of the medical advances of the past 50 years which have increased healthy longevity. The purpose of the chapter is to describe the relationship of the endocrine system and critical hormones which play a role in developing the author's understanding of the obesity health problem.

Chapter III– Sufficient muscle strength is one of the essential components for normal movement production and control, and is determined by many factors such as muscle cross-sectional areas, muscle fiber type compositions and muscle architectures. This chapter focuses on three other aspects that influence the strength performance of subjects with or without injury. Firstly, the strength will be influenced by anthropometric variables, especial the fat composition. Evidence shows that the strength difference between genders is largely affected by the difference in fat composition. While the fat composition covariate is controlled, the effects of gender on strength then become not significant. Secondly, the strength measurement results will be misleading if the measuring method is unreliable. In studies of investigating the reliability of isokinetic knee strength and the isometric hip and knee strength by handheld dynamometer, it was found consistently that the testing position is crucial to improve the reliability; changing the testing position from the traditional prone to prone-standing for hip extensor strength could effectively improves the strength measurement reliability. With the provision

the relative and absolute reliability, the authors could also know which measurement methods are reliable, and more clinically useful, how much the strength increasing could indicate a real improvement for a single individual. Finally, the recovery of strength deficits after incidents such as ACL rupture or reconstruction should be carefully monitored, as evidence shows bilateral weakness may exist after an unilateral injury, and the weakness of the affected knees may even exacerbate early after the reconstruction procedures. Evidence also shows part of the strength insufficiency could be explained by muscle recruitment failure. Therefore, a holistic investigation upon strength performance including understanding the body composition, measuring the extent of weakness and voluntary activation, with carefully selected procedures, should be necessary for designing an effective strengthening program.

Chapter IV – *Objective*: to identify the relationship of demographic, socioeconomic and obstetric variables and perceived stress on physical health among Macao Chinese pregnant women. *Design*: a cross-sectional and exploratory quantitative study. *Settings*: an antenatal clinic of a university-affiliated regional public hospital in Macao. *Participants*: a community-based sample (n=717) pregnant women in the second trimester. *Measurements*: perceived stress was measured by the Perceived Stress Scale (PSS), and Physical Health was measured by the standard SF-12 Health Survey (SF-12). *Findings*: a multiple linear regression analysis revealed that pregnant women who were secondary or lower education attainment ($\beta = .105$, $p = 0.013$), had better interpersonal relationship with family members ($\beta = 0.108$, $p = 0.014$) who lived in bigger residence size ($\beta = 0.085$, $p = 0.041$) without obstetric complications ($\beta = 0.085$, $p = 0.026$) and perceived lower stress level ($\beta = -0.096$, $p = 0.017$) had better physical health among Macao pregnant women. *Conclusion*: preliminary information was provided about Macao Pregnant women who had better physical health during pregnancy that was associated with the demographic, socioeconomic, obstetric, and perceived stress variables. *Implications for practice*: the development of a checklist or structured questions was necessary for clinical situations and tailor-made a program of enhancement of physical health during pregnancy.

Chapter V – The growing interest of children in games has promoted educators to employ computer games for pedagogical purposes. The purpose of this book chapter is to describe how 5th graders designed educational computer games about nutrition for younger children. As a part of class-wide project, the students were asked to design educational games that would teach first graders about nutrition. This chapter explored students' knowledge about

nutrition concepts. Children used the software *GameMaker* to design their games. This chapter describes how children took on the roles of user, tester, and designers of games and learned while taking these roles. The authors examined the representations of the nutrition concepts in the games, characteristics of the games, design strategies, and collaboration among students in the author's research. Results from three separate student cases are presented.

Chapter VI – Cooperative learning is considered among the most effective teaching strategies in education. Yet, so far, there is limited evidence regarding its application in physical education. The present study was designed to investigate the impact of different cooperative teaching strategies on students' motivation and learning strategies. The participants were 272 high school students (age ranged from 13 to 15 years old) divided in four groups. Students in all groups were taught the same football task; in groups A and B using the teaching games for understanding approach (in group A students were divided in homogeneous groups in terms of ability and in group B in heterogeneous groups), and in groups C and D using the skill execution approach (in group C the reciprocal style was used and in group D the practice style). After the end of the teaching unit, all students completed the Situational Motivation Scale and the Motivated Strategies for Learning Questionnaire. The results of the analysis indicated that students in the reciprocal style group reported higher scores in help-seeking compared to those in the practice style group. The findings of the present study provide useful information regarding the application of cooperative learning strategies in physical education.

Chapter VII – *Aims* To help community-dwelling older persons increase their knowledge and awareness of nutrition intake in daily living and engage with their health status through six consecutive weeks of a Nutrition and Lifestyle Program (NLP) in elderly community centers. *Background.* In Hong Kong, older persons aged 65 or above comprised 13.0% of the total population in 2010; this is expected to increase to 28% of the total population by 2039 (Census and Statistics Department, 2010). Because of the growing number of older persons, the healthcare system may be better focused on prevention than treatment. According to a report from the Census and Statistics Department (2008), about 90% of older persons (85,571 out of 852,796) were living in domestic households, and the rest were living in institutions with residential care in 2006. The ageing population is increasing worldwide. Nutritional education is necessary for community-dwelling older persons since they are at high nutritional risk due to functional and cognitive decline in the aging process, diet-related chronic illness and poverty. According to the food policy

in Hong Kong, nutritional labeling was commenced on 1st July 2010; older persons may require basic knowledge in food choices and adequate food to maintain optimal nutritional status. *Methods and Intervention.* The Nutrition and Lifestyle Program (NLP) was conducted in association with the elderly center in the community. Twenty-five community-dwelling older people from the elderly centre were invited to join the 6-week NLP, which covered nutrition and common chronic illness among the elderly, the food pyramid of basic nutritional needs, identifying healthy and unhealthy snacks and food (e.g. those high in cholesterol, saturated fat, and salt), meal planning, nutritional labeling, and encouraging physical activity. The NLP started with collecting demographic data (age, gender, health condition, educational level, financial situation and religion), in addition to information related to diet and exercise habit, basic nutritional assessment including calculation of Body Mass Index (BMI), measurement of mid-arm circumference, and collection of data in regard to food preferences. *Outcomes and Conclusion.* As expected, results showed that older persons can enhance their nutritional knowledge. They can empower themselves with such knowledge in their daily living, thus reducing their nutritional risk and achieving better disease management through diet therapy. After the NLP, the older people had significantly increased their meat and fluid intake ($p < 0.05$). In addition, there was an increase in their consumption of fruits and vegetables, although the improvement was not significant. Besides the improved nutritional intake, physical exercise was significantly increased too ($p < 0.05$). It seems that at last it is possible for the elderly to retain their health and enjoy their life in the community rather than in the care of an institution.

Chapter VIII – Traditional nutrition education programs that target obesity often focus on educating participants on meal planning, appropriate food choices, and reasonable portion sizes. While these are three important factors related to the education of healthy eating and weight management, instruction to consumers on the application of this knowledge with the development of the skills necessary for preparing healthy, appealing foods needs reinforcement. Nutrition education programs that focus on culinary skill development have been shown to be effective methods for improving the nutrition behavior of program participants. This chapter walks you through the complete process from designing to developing and finally implementing an engaging and unique culinary nutrition education program. Cooking with a Chef (CWC) has been delivered to a wide range of audiences and is used as an illustration of a well-executed program that utilizes key components, such as the pairing of a

professional chef and a nutrition educator for delivery of the program, hands-on cooking activities, and an interactive learning environment.

Chapter IX – Maternal nutritional status before and during pregnancy constitutes one of the most important determinants for fetal growth. Inadequate body weight before conception and low maternal weight gain are associated with adverse perinatal outcomes. The fetal origins hypothesis proposes that inadequate maternal nutrition and a low infant birth weight can predispose the child to diseases such as, diabetes and cardiovascular disease later in life. Pregnancy can be an opportune time to improve nutrition, and presents an ideal time for health promotion activities. However, many women of childbearing age do not maintain good nutritional status before and during pregnancy. They do not have an opportunity to get adequate and appropriate nutrition education in antenatal care. Most of them expect advice on general dietary improvements, with the remainder seeking advice on helping to promote their quality and quantity of nutritional intake. All women of reproductive age should be encouraged to follow the Government recommendation and eat a well-balanced diet. Health care providers need to ensure pregnant women know the positive and negative effect of poor maternal nutrition status, including the need for additional folate, at each physical check-up. An individualized approach is likely to have better outcomes than a standard intervention that is given to all pregnant women. A critical goal to achieve is for women to make behavior changes for good nutritional status before, during, and after conception, which may lead to improved birth outcomes.

Chapter X – Nutrition education programs have been implemented in the workplace in an effort to improve the diet and lifestyle of employees and, therefore, reduce the incidence of many chronic diseases linked to overweight and obesity including, diabetes, cardiovascular disease and cancer. Despite the importance of this outcome, the success of these programs has varied. This chapter uses a qualitative, narrative approach to review research conducted over the past 10 years on nutrition programs in the workplace and attempts to identify those aspects associated with successful behaviour change among employees. This approach enables us to include a variety of methods of intervention and data collection and thereby allows identification of promising intervention approaches that might not be identified in review approaches that are based on quantitative meta-analyses.

The chapter reviews the evidence for both the efficacy and the effectiveness of nutrition education programs in the workplace (i.e., whether an intervention works under ideal, well controlled conditions, versus whether

the intervention works in the “uncontrolled” real-world work place) (Spraycar, 1995). In addition, the characteristics of efficacious and effective programs are described including the duration of the nutrition education programs, the type of programs offered to employees, and the settings in which the programs were implemented. The results of the review suggest the workplace is a viable context for delivery of programs designed to change food intake behaviours, and overweight and obesity prevalence, although the challenge is to achieve sustained change on these outcomes after the intervention concludes. The results of this review should be taken into account when planning future work-based education programs on nutrition.

Chapter I

Physical Activity in Obesity

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Introduction

Obesity is a major health problem [1, 2] and it is considered a chronic disease by the World Health Organization [3]. The definitions of overweight and obesity are based on body mass index [BMI], the bodyweight in kilograms divided by the squared length in meters. In adults, overweight is defined as a BMI of 25.0 to 29.9 kg/m², and obesity is defined as a BMI of 30.0 or higher. Obesity is further subdivided into grade 1 [$30 \leq \text{BMI} < 35$], grade 2 [$35 \leq \text{BMI} < 40$] and grade 3 [$\text{BMI} \geq 40$], the latter also referred to as morbid obesity [4, 5]. Both a reduction of food intake and an increase of physical activity are advantageous to reduce body weight.

In this chapter, the authors outline the pervasiveness and impact of the obesity epidemic and provide a summary of the common treatment of obesity and specifically of the role of physical activity as a treatment option. Furthermore, having outlined the influence of psychosocial factors in obesity

treatment, an overview of possible physical exercise interventions will be given. Finally, the importance of motivation in physical exercise education in obesity and some practical tools will be offered.

The Obesity Epidemic

Currently at least 400 million adults worldwide are obese [3]. Obesity is especially, though not exclusively, prevalent in wealthy countries [6]. Even between wealthy countries, the prevalence of obesity differs considerably [7]. In the Netherlands, about half of the adult population is overweight [including obesity], and 10-12% is obese [8]. In the United States, the most recent estimate of the prevalence of obesity was 34%, and the combined prevalence of overweight and obesity was 68% [9]. Also within nations disparities exist: in wealthy countries the prevalence of obesity is higher in people with a lower socio-economic status [10, 11] and there are consistent racial differences [12-14]. Obesity is a relatively recent public health problem and there is no evidence that it will have reached its maximum in the near future [15]. Moreover, the increase in overweight and obesity during their lifetime seems to become more prominent in younger, as compared to older generations [16, 17].

The increase of the BMI goes with a concomitant increase in physical, psychological, and social health problems. Obesity is a risk factor for diabetes, cardiovascular disease and several other complications of the metabolic syndrome, including sleep apnea, gall bladder problems, poly-cystic ovarian syndrome, fatty liver, gout, as well as for several types of cancer, diseases with orthopedic complications -especially osteoarthritis [18]-, and overall morbidity and mortality [19-21]. In general, there is an excess of unhealthy years lived in obesity, as compared to persons with a normal weight. Not only obesity, but also lack of physical activity is an important independent risk factor for several co-morbidities [22, 23]. The percentage of adults that meets the level of healthy physical activity is less than 40%, and even lower in persons with overweight or obesity [24-26]. The combination of overweight and low physical activity results in a higher increased health risk than the risk exclusively caused by overweight or low physical activity alone.

Although the majority of obese persons has no overt psychiatric disorders [27, 28], obesity is associated with mental problems such as depressed mood and low self-esteem [29, 30]. The relationship between depression and obesity is especially strong in higher educated women, persons seeking obesity

treatment, and in binge eating disorder [BED] [27, 31], which is characterized by uncontrollable eating of unusually large quantities of food in a relatively short period of time, and a depressed and guilty feeling afterwards [32].

In addition to psychological problems, obese people may experience social problems such as reduced chances for education and to find a job, but also bullying, stigmatization and discrimination, often from a young age onward and [33, 34]. Obesity is often perceived by the non-obese as something preventable and some see lack of self-discipline and motivation as the only cause of obesity [33, 35]. Even family of the obese and obesity health professionals may hold this belief toward obese persons [36-38].

Among other causes, obesity is indeed the result of a disturbed balance between energy intake and energy expenditure. However, this view over simplifies the complex etiologic mechanisms underlying obesity, and it may easily lead to considering obese persons as persons who eat too much and move too little. The far more complicated truth is that in obesity, apart from nutritional factors and physical inactivity, also genetic, hormonal, psychological, and socio-economic factors play a role [39]. Major contributors to the obesity epidemic are environmental factors. The easy access to unhealthy calorie rich food and decreased need for physical exertion, have led to an almost inevitable energy disbalance [40, 41]. Whereas those of our ancestors who had a genetic constitution that helped to store energy for periods of scarcity were at an advantage, in the contemporary calorie rich environment, these so called 'thrifty genes' are a major disadvantage [42, 43]. From an ecologic perspective, obesity should not be regarded as a problem caused by irresponsible behavior of individual persons, but as a normal response to an abnormal environment [44, 45] [see figure 1].

Physical Activity and other Treatment Options

Many obese persons do not seek medical treatment, but if they do, most of them are motivated because they suffer from co-morbidities or otherwise reduced quality of life [46, 47]. Treatment modalities are often categorized into conservative treatment and bariatric surgery.

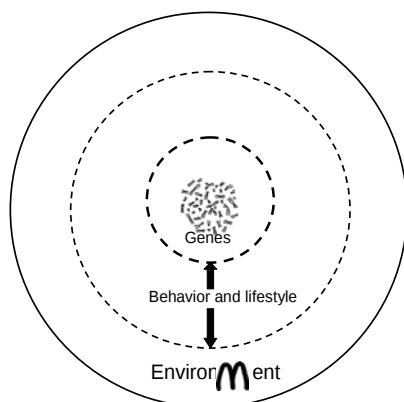


Figure 1. Obesity is determined by the interaction between genes, behavior and lifestyle, and environment.

Conservative treatment of obesity consists of the combination of reduced caloric intake, enhanced physical activity, and [psychological] support for lifelong lifestyle changes [48]. Some clinical trials evaluated whether drugs could improve the results, e.g., Orlistat to diminish lipid resorption in the digestive system or Sibutramine to enhance satiety [49, 50]. Although medications can significantly increase weight loss compared with placebo in most trials, all medications have side effects such as an increase in blood pressure and heart rate or gastrointestinal problems [49, 50]. These side effects need to be considered before initiating treatment and they may require discontinuation of the drug.

For morbidly obese patients the conservative treatments do not suffice, and for them bariatric surgery is currently the most successful treatment option for weight loss [51]. Bariatric surgery not only reduces weight but also favorably influences co-morbidities [52] and improves quality of life [53, 54]. Many everyday life activities change after surgery and weight loss: patients experience less difficulty when moving around, they are better able to perform daily tasks such as cleaning the home, and they experience a higher body satisfaction and self-esteem due to the weight loss and other psychological factors [55, 56]. However, although bariatric surgery is generally successful, it is not a panacea. Continuous treatment aiming at life-long change in lifestyle remains mandatory in order to sustain the effects of surgery [57-60].

In all obesity intervention programs the promotion of physical activity may play a role for several reasons. Although physical activity alone can be an effective strategy for weight reduction [61, 62], it will most often be

unsuccessful if food intake is not changed as well. Moreover, trying to lose weight with physical activity as a solitary intervention implies strenuous training, which is often difficult to sustain for obese persons. Weight loss as such is not the primary aim of physical activity interventions; a more important goal is that physical activity contributes to the sustainability of the diet induced weight loss [63, 64]. This effect of combined diet and physical activity interventions has even been observed with less strenuous forms of exercise [63, 64]. Another reason for physical exercise in the intervention program is that it can reduce the risk for somatic co-morbidities of obesity such as metabolic and cardiovascular disorders [22, 64-67]. Finally, favorable effects on mental and social health, such as more self-esteem, less depression, improved body satisfaction and, in general, improved quality of life have been reported as a result of physical exercise programs [68-74].

Role of Psychosocial Factors in Treatment

Interventions aiming at reduced calorie intake and enhanced energy expenditure have proven to be effective, but the effects in the long run are disappointing [75]. Moreover, many patients drop out from the treatment program making these programs difficult to evaluate [76, 77]. Some factors that explain the high drop out rate in obesity programs have been identified. Examples of such factors are: experiencing low quality of life, high outcome expectations, a high number of previous dietary attempts [76, 78-81], and the co-occurrence of depression [82]. Other factors that partly explain why obese people tend to stop training programs prematurely or never even start to enhance their physical activity are lack of access to and availability of sports facilities, having no friends who participate with them in exercise, and lack of social support especially by members of the family [83].

In addition to environmental and social barriers such as those mentioned, personal barriers influence exercise participation [84]. One barrier is that obese persons consider physical exercise as being dangerous or unnecessary [85-87]. Fear of injury is a major factor in overweight healthy persons not to start physical activity [88]. There is indeed evidence that obese persons have a higher risk of injuries in general, as a result of posture disturbances [89]. The odds for injuries needing medical treatment is up till 48% increased in overweight as compared to normal weight people [90]. Especially lower extremities are more prone to injuries [head injuries are less prevalent among the obese]. On the other hand, when physical activity is prescribed as a part of

weight loss programs, there is no increase of injuries compared to those who stay sedentary [91]. All together, those who are professionally involved in training obese people should take both fear of injury and an increased risk of injuries seriously.

Next to fear of injury, other psychological barriers for physical activity have been described: obese persons tend to perceive themselves as incompetent in sportive activities [92], they feel ashamed about their appearance and have a lack of self-esteem [93, 94], they may consider themselves as too obese to be able to exercise [95], or they experience that sportive activities are unpleasant [96, 97].

Also weight stigma - often present from early life onward - restrains obese persons from starting and adhering to physical exercise programs [98, 99]. A stigma is defined as a characteristic that is associated with negative stereotypes, and persons carrying this stigma, suffer from discrimination and reduced social status [100]. Especially, if such a stigma is internalized, this can negatively affect individuals' physical activity [98, 99].

Reasons why obese persons eventually do start a program are often induced by negative cues that are the consequences of obesity, such as comorbidities or a very low quality of life [101].

Physical Exercise Interventions

The success of physical exercise interventions in obesity appears to depend on specific points of attention that are to be taken into account. In this paragraph some general characteristics of physical activity programs are outlined, the need for psychological intervention in specific cases is described, and the importance of the right attitude of the trainer or [physio]therapist is stressed.

Physical Activity Programs

In an extensive review including a range of physical exercise programs, it was concluded that exercise as a weight loss intervention is effective [102]. Besides effects on weight loss, aerobic exercise results in reduction of diastolic blood pressure, triglycerides and fasting glucose, thus improving cardiovascular risk factors even when no weight is lost [102]. The American College for Sports Medicine [ACMS] recommends a minimum of 150 to 250

minutes per week of moderate intensity physical aerobic activity to prevent weight gain [103, 104]. Weight loss with this frequency is only moderate, and most constantly achieved if combined with diet restriction [104]. Amounts over 250 minutes of physical activity provide more significant weight loss. Moreover, if physical activity of moderate intensity is carried out during at least 250 minutes per week, weight maintenance after weight loss also improves. For practical purposes, the ACMS gives guidelines for training [frequency, intensity and duration] in the initial stage [1-4 weeks], the improvement stage [5-24 weeks] and the maintenance stage [over 24 weeks] with specific modifications for obese persons [104]. Because the fat burning zone lies at a lower level as compared to the aerobic zone, obese people are recommended to train at a relatively low intensity and make use of the overlap between the two zones. This implies on average training between 60 and 80% of the maximal heart rate [105].

Most weight loss programs consist of aerobic exercises to which sometimes resistance training is added. Adding resistance exercises to aerobic exercises was found to increase the fat free mass [103]. A recent meta-analysis showed favorable effects of resistance training on type 2 diabetes [e.g., HbA_{1c} levels] and systolic blood pressure [106], and resistance training is therefore recommended as part of the obesity treatment program. The ACSM gives comprehensible guidelines on how resistance training can be carried out [104].

Aquajogging is an exercise activity suitable for obese persons, combining safety with both aerobic and resistance training. It is a low impact sport, also used in rehabilitation [107, 108], and has a favorable influence on body composition and fitness [109-111].

Psychological Guidance

Although physical activity plays a main role in the treatment of obesity by the [physio]therapist, it has been suggested that in some cases psychological guidance targeting eating behavior can be of use.

This needs some explanation on eating behavior for understanding the association between food intake, eating behavior and stress. Three types of eating behavior are distinguished: restrained eating, external eating, and emotional eating [112].

In case of *restrained eating*, periods of dieting are alternated by periods of excess eating, eventually causing weight gain [also called the jo-jo effect or weight cycling].

In *external eating*, environmental triggers cause eating: the seeing or smelling of food induces the desire to eat and snack. As a cause of unhealthy eating, this pattern is seen more often in men as compared to women. External eating is a relatively healthy and natural behavior if considered in the light of evolution: in ancient times food was scarce and prone to decay. Being able to swallow a lot of food whenever available, was a favorable characteristic. In modern times with a lot of food available, a strong urge to eat when seeing or smelling food may be an important factor causing obesity to persist.

Emotional eaters are persons finding comfort in eating. This behavior is more common in women and is considered a non-natural reaction to stress: a more natural stress reaction is a decrease in food intake [113].

There is hardly evidence-based knowledge with respect to the psychological treatment of these eating behavior patterns, although it can be helpful to recognize eating patterns at the start of treatment when coaching obese persons. Especially emotional eaters may require psychological guidance such as stress management training, and might benefit from relaxation therapy, as an alternative reaction to stress. Also cue exposure therapy, which focuses on breaking the learned reflex to eat, could be helpful in case of emotional eating or external eating [114]. For physical activity coaches [e.g., trainers, physical therapists, fitness instructors], recognizing an emotional eating pattern can be an indication to include a psychologist in the intervention team.

Attitude of the Therapist

Every day of their life, obese persons may suffer from the physical and psychological burden of obesity. Discrimination and stigmatization are pervasive phenomena, even now that a large part of the population suffers from obesity. At work, in job finding, with respect to promotion opportunities, and even within families, discrimination is prevalent [33, 37]. Also obese persons themselves associate obesity with negative person characteristics [115]. A recent study found that being conscious of weight stigma negatively affects the willingness to engage in physical activity [116]. If obese people hold the misconception that physical activity is something for lean persons, this reinforces the stigma of laziness and lack of will power. It has been observed that also in people who professionally deal with obesity, stigmatization is prevalent [117]. Negative associations with obesity such as gluttony, sloth, lack of will power, and lack of intelligence, are often

unconscious and implicit [118, 119]. If such beliefs are not recognized and acknowledged by the professional, they can harm the therapeutic relationship.

Motivation

Obesity is partly a congenital chronic health problem that just like other chronic health problems, calls for a life-long approach. To ultimately target this health problem, it is of utmost important to gain self-control. Most training programs that have been evaluated and are referred to in literature have however, a limited duration. Professionals should be aware that the short duration of treatment programs are not wrongly interpreted by the patient that the training is a curing treatment which solves the problem forever, or that the disease is incurable if no weight reduction occurs. Communication of the belief that enhanced physical exercise should be a life-long commitment is therefore an important ingredient of any therapy.

As dissimilar factors relate to the motivation to start, and the motivation to sustain physical activity, the stimulation of the development of self control and self regulation will likely be most successful when the phase of motivation of the patient is taken into consideration. Self-determination theory and the technique of motivational interviewing, can offer help to achieve this.

Self-Determination Theory

Using a learning theory paradigm to explain behavior in terms of stimulus-response contingencies, several theories have been developed to throw light on human motivation. Recent examples are the self-efficacy model [120] and self-determination theory[121]. Self-determination theory will be discussed.

According to the theory of self-determination three basic needs determine motivation: autonomy, competence, and social relatedness. Among these three, *autonomy* takes a central position: if a behavior is autonomous, it is voluntary, originating from one's own values, and self-determined. *Competence* refers to the necessity to experience that one is really able to achieve something, and is related to the construct of self-efficacy [122]. The third basic need, social relatedness, is the extent to which one finds support in one's environment, including the coach or therapist. High levels of autonomy, competence and social relatedness, enhance self regulation.

Motivational interviewing can be considered as a practical implementation of self-determination theory [123], in which the basic assumption is that the motivation to change lies within the patient, but that the patient experiences ambivalence towards behavioral change. The role of the therapist is predominantly a coaching one [124]. Motivation is considered to be a qualitative rather than a quantitative concept. It can vary from fully extrinsic [determined by external factors, e.g., a doctor’s prescription] to fully intrinsic [an expression of complete autonomy]. Extrinsic motivation and intrinsic motivation are considered to be two extremes on a continuous scale. Steps can be made to proceed from the extrinsic to the intrinsic pole. The therapeutic relationship can influence this process [125].

The self-regulation level increases as motivation proceeds from extrinsic to intrinsic [figure 2]. The first step from extrinsic towards intrinsic regulation is called ‘introjected regulation’. Introjected regulation implies that a person has adopted external values, senses an obligation or a certain internal pressure, without the sense of freedom to resist this pressure. One step ahead is called ‘identified regulation’, in which one’s behavior is not regulated by a [negative] sense of obligation, but more strongly by the sense that the behavior is profitable. The next step is called ‘integrated regulation’, in which behavior is similar to one’s own values and fits one’s personality. At this stage self-regulation originates [126].

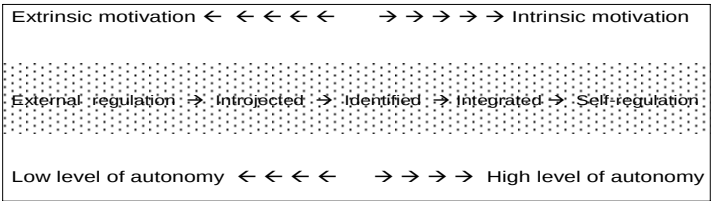


Figure 2. descriptive model of regulatory processes in proceeding from extrinsic to intrinsic motivation. Adapted from Silva et al. [126].

Adherence in Practice

The introduction of the principles of self-determination theory and motivational interviewing in physical activity programs is relatively new. Initial results seem favorable with respect to drop-out [127]. Most obese persons start training with an overt extrinsic motivation, e.g., because they are sent by their physician [physical activity on prescription], or because they or

their environment are not content with their appearance or with their health status [101]. From the perspective of self-determination theory, therapy not only aims at coaching and setting physical goals, but also at coaching the evolution into intrinsic motivation and self-regulation. The basic needs of the patient are leading in the supervision. Reasoning from the basic needs, especially the need for autonomy, the possibilities and goals of the patient are guiding principles for setting the intensity and frequency of the training program. Evaluation of these personal goals, and not the exercise program itself, leads to constant adjustment of the program. Within this approach, standardization of the exercise program is to be avoided. Ambivalence, barriers and difficult moments need to be expressed by the patient and are discussed with the therapist. There are no standard solutions; solutions are generated from the patient himself.

In order to meet the basic need of 'competence', one tries to find an exercise modality that matches the patient, brings satisfaction, and is experienced as something pleasant. For motivation to occur, it is important that one is able to achieve something. This may often imply that too much exertion should be prevented, or that the increase of effort should be gradual. For obese persons also cognitions such as fear of injury and actual injuries may be important threats to competence that should be taken account of, e.g., by choosing a pleasant activity with a relatively low risk at injury such as dancing or aquajogging.

Finally, social relatedness is factor that facilitates the development of self-regulation. This asks for an empathic attitude of the therapist. The involvement of family, and training in groups, can further reinforce the support of one's environment.

Practical Tools

In order to apply the principles of motivational interviewing into the practice of physical exercise education, some tips are given here:

1. Supporting Autonomy

Supervision helps the patient to exercise in a manner that fits his own possibilities and desires. Autonomy is reinforced if the patient is able to make personal choices about the type and intensity of the training program and about

training independently [e.g., in the home environment and during activities of daily life] or in groups. Circumstances that help to achieve physical activity as well as reasons to be inactive or barriers that hamper exercise are to be discussed. Writing down encouraging and obstructing circumstances in a logbook can help to clarify, discuss and overcome barriers.

2. Improvement of Competence

At the start of the program, clear information can be given relating to the complex causal factors associated with obesity, and the physical, psychological, and social consequences. Information on energy expenditure and energy intake, and the role of physical activity in this respect, helps to gain insight into the problem. This information should lead to a realistic view of what is to be expected and what is not to be expected of a training program.

Often persons have great expectations before the start of the program and consequently unachieved goals afterwards. Too high expectations will increase the risk of drop-out. It will help when goals are made explicit and translated into achievable goals. Explanation of barriers and side effects related to the different stages of motivation, supports realistic goal setting. Patients will better understand that advantages of physical activity are not instantly discernable. These effects, e.g., experiencing more energy and vitality, relaxation, and increased self-esteem for having reached measurable results, will only develop in the long run.

Practical information about the general build-up of the program [in broad terms] and about clothing and shoes, is also to be given.

3. Stimulation of Social Relatedness

Persons need to experience that they are supported and that their efforts to enhance their physical activity or loose weight, is part of a social context. This can be attained by an empathetic, supporting and inspiring relationship with a therapist. Positive feedback on achieved goals not only increases the sense of competence, but also strengthens relatedness. To improve relatedness also specific [sub] goals can be defined, e.g., making more frequent walks with a partner or friend. Another way to increase social relatedness is organizing group activities. [Sportive] activities outside the training setting will further contribute to relatedness.

Summary

Physical exercise education in overweight and obese patients not only requires knowledge of physical exercise programs, but also knowledge of psychological processes such as cognitions that may hamper adherence to the exercise program and knowledge of social processes, e.g., consciousness of the stigma of obesity. The primary concern of an educational program is not weight loss, but a more active lifestyle that is sustainable during the rest of one's life. At the start of a program an appraisal of expectations and motivation of the patient is necessary. During the program the patient's autonomy needs to be leading and the therapist has both an expert- and coaching role. By empowering the patient and improving physical competence and motivation to exercise, self-regulation increases and the chance at long standing success improves.

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Chapter 11

The Endocrine System and Obesity

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Abstract

The number of individuals in the United States and across the globe who are overweight or obese has reached epidemic proportions. The science and health care surrounding the study of obesity has expanded significantly in the past 20 years. Researchers use animal and human investigations to describe biological processes associated with nutrition and the regulation of the body's intake, utilization, and storage of excess nutrient energy as fat. The endocrine system plays a major role in the regulatory mechanisms of energy supply and demand. Endocrine signals responsible for hunger and satiety such as leptin, adiponectin, and ghrelin are produced from adipose tissue and from the intestine. These signals are integrated in the hypothalamus and other areas of the central nervous system influencing eating behavior. The non-exercise energy thermogenesis (NEAT) required for routine daily living may play an important role in understanding obesity and the struggle for weight control. Obesity is the result of dysfunction of this complex, energy

regulatory system. The mechanisms which evolved over thousands of years to assure a sufficient energy supply during times of famine and competition for a limited food supply, are now overwhelmed by the abundance of high energy, easily and inexpensively obtained food; marketplace pressures on eating such foods; and an ever increasing sedentary lifestyle decreasing energy utilization. The result is an epidemic of obesity and its attendant co-morbidities of cardiovascular disease, metabolic syndrome, diabetes mellitus, musculoskeletal disorders, and cancer which threaten to undo many of the medical advances of the past 50 years which have increased healthy longevity. The purpose of the chapter is to describe the relationship of the endocrine system and critical hormones which play a role in developing our understanding of the obesity health problem.

Introduction and Background

The endocrine system consists of specific glands that secrete hormones that affect every cell in the human body and regulate metabolic activity. In the study of obesity that is currently playing a major role in research within the biological sciences, pharmacology, nutrition, exercise science, and behavioral sciences the relationship of hormones to obesity is very important [1-6]. The obesity epidemic in the United States [7] and pandemic identified by the World Health Organization [8] threatens the advances in health care that were accomplished in the 20th century. There are reports by life-course epidemiologists that lifespan will begin to decrease in the 21st century, after years of increase in the presence of modern health practices [9-10]. The decline in lifespan for the younger generation is attributed to the current health reports indicating obesity as a major health concern that has deteriorated the health of Americans and continues to be on the rise worldwide. There is ample data and specific knowledge about health conditions that are negatively impacted by obesity such as cardiovascular disease [11], diabetes mellitus [12], fatty liver disease [13], musculoskeletal disorders [14], and cancer [15].

The purpose of this chapter is to provide an overview of the endocrine system specific to factors affecting weight control in overweight and obese individuals. Critical areas of study that will be summarized include: (1) metabolism and non-exercise activity thermogenesis; (2) estrogen effect on weight throughout the life span; (3) polycystic ovarian syndrome—the most common endocrine disorder; (3) adipose tissue and adiponectin; (4) leptin and

ghrelin in hunger and satiety; and (5) hypothalamic-pituitary function in obesity.

Metabolism and Non-Exercise Activity Thermogenesis

Metabolism is the function of converting food intake to energy that fuels the body to process the cellular and organ functions needed to sustain life. The health of the organism depends on a metabolic function that meets the needs of the body tissues and structures. The basal metabolic rate is the energy needed for the human body to operate all the functions of the body while at rest. [16] The metabolic rate for individuals varies based on factors such as height, weight, age, and body type [16].

Calories are the food energy needed to support the metabolic functions of the body. In persons with normal body weight the energy they consume in calories is equal to the energy needed for the body's metabolic functions. In persons with low body weight, the caloric intake is less than the energy needed for metabolic function. Those individuals do not store excess energy in the form of fat. The opposite is true for persons who are overweight or obese. The amount to caloric energy consumed is greater than the energy expenditure needed to meet the metabolic functions of the body. The excess energy consumed is stored in the form of fat or adipose tissue.

Total daily energy expenditure consists of three components: (1) basal metabolic rate; (2) the thermic effect of food; and (3) the energy expenditure of activity [16].

The energy expenditure that prevents obesity is a negative energy balance where the amount of energy in calories consumed is less than the amount of energy needed to operate body functions.

In overweight or obese individuals the energy expenditure is positive: There is greater consumption of caloric energy than is required to operate the body functions. Excess energy is stored as fat. Fat is an organ that is bioactive and contributes to hormone production (1). There are different types of fat—(1) brown adipose tissue and (2) white adipose tissue. Research in mouse models has identified different functions with the different types of adipose tissue (1).

Thermogenesis is the heat produced during metabolic function [4, 16, 17]. Heat is the byproduct of energy consumption. Skeletal muscle and fat are

involved in thermogenesis. Exercise is used as a means of increasing the body's energy consumption and utilizing the fat stores to obtain the energy needed during increased physical activity [18-20].

There are two types of thermogenesis: (1) "Obligatory thermogenesis", defined as heat production needed at rest for all cellular reactions that assures sustainability of living cells, tissues, and organs; and (2) "Facultative thermogenesis", defined as heat production over and above obligatory thermogenesis. The two major systems for facultative thermogenesis are the skeletal muscular system and adipose organ system [4].

Non-exercise activity thermogenesis (NEAT) is defined as the energy expenditure that occurs not as a result of voluntary exercise but as a result of daily living routine [16]. NEAT is the energy expended in the course of conducting the activities of daily living such as maintaining posture in standing, sitting, while walking; gardening; and other skeletal muscle function activities such as chewing, breathing, and self-care hygiene [17].

Although NEAT is a critical variable in the total energy expenditure of humans very little is known about the role of NEAT in spontaneous physical activity and specific to weight control and obesity [6]. Research is currently targeted at investigating the relationship of NEAT to the central nervous system [4, 6, 20] and the endocrine functions [1, 2, 4-6]. The role of NEAT in the study of obesity is under investigation [4, 6, 16-17, 21-23]. Researchers are investigating the relationship of NEAT to weight reduction in obese persons. There is evidence that even as dietary quality has improved and caloric intake reduced, obesity persists [6]. Leibel et al. [22] report findings where when a person loses a percentage of body mass the NEAT is altered downward therefore lowering the energetic efficiency. The individual who has adjusted caloric energy intake to promote weight loss may now have also lowered the energy requirements for NEAT or improved the body's efficiency. Novak and Levine [6] also report that the lower energy requirements may result in failure to lose additional weight or may contribute to weight gain after weight loss despite adherence to caloric intake needed for negative balance in metabolic function. To maintain the NEAT energy expenditure at the individual's pre-weight loss level, Leibel et al. [22] had subjects don a vest with weights that match the number of pounds lost. By maintaining the NEAT level similar to prior to the weight loss, the body is prevented from adjusting downward and maintains higher level of energy expenditure and weight loss is maintained. Levine et al.²³ investigating the effect of NEAT related to posture and physical activity have reported that persons who stand and ambulate are leaner than persons who sit for 164 minutes per day.

The role of exercise as a means of increasing energy expenditure and promoting facultative thermogenesis of the skeletal muscle and adipose tissues has been extensively investigated and is universally accepted as a means for weight control and weight loss [2, 18-20]. The relationship of hormones – chemical messengers—to NEAT and obesity is being investigated [1-6]. The following section will specifically address some of the more commonly investigated hormones implicated as multifactorial regarding weight and obesity.

Estrogen and Obesity

Childhood and the Reproductive Years

Estrogen has little known effect on general intrauterine growth and development. Female phenotypic sex is determined by the absence of testosterone rather than the presence of estrogen. Sexual orientation and the cyclic production of pituitary gonadotropins (FSH,LH) controlled by hypothalamic GnRH production is influenced by estrogen during neural development[24-26]. The programming of childhood growth begins *in utero*. Small-for-birth infants and rapid early childhood weight gain result in earlier pubertal onset and an increased risk of obesity and insulin resistance (IR) later in life [24, 27-30].

The onset of puberty is heralded by a rising level of estrogen produced by the ovaries that results in selective deposition of adipose tissue on the thighs, hips, and breasts during puberty causing the characteristic female body habitus. Childhood obesity in the presence of insulin resistance results in early adrenarche (pubic and axillary hair); premature breast development; and early menarche[31]. Girls who are obese have higher levels of estrogen.

Obesity in adolescence is a significant predictor of adult obesity and Metabolic Syndrome (MS). MS is defined as having three of five health conditions including: hypertension, dyslipidemia, central obesity, elevated cholesterol, elevated triglycerides, and elevated fasting blood glucose. MS represents a serious lifelong health risk for adolescents³². MS also contributes to adverse psychosocial factors during adolescence stemming from limited participation in sports and physical activity as well as social interactions due to being obese. The long-term effects of MS are catastrophic in children and adolescents³². Identifying factors affecting total energy expenditure in children including basal metabolic rate, thermal effect of food, and the energy

expenditure of activity for NEAT and for volitional exercise is critical to the management of childhood obesity. Intervention prior to puberty has the best chance of success. Increasing NEAT in children and adolescents through increase physical activity may both prevent and treat childhood and adolescent obesity [6].

Estrogen, Obesity and Polycystic Ovarian Syndrome in Adolescent Females

Polycystic Ovarian Syndrome (PCOS) represents a subgroup of obese adolescents who are at especially high risk for developing type 2 diabetes mellitus (DM2), cardiovascular disease and a number of different cancers at an early adult age. Although usually associated with obesity, visceral obesity and IR are present even when corrected for body mass index (BMI) [33]. Up to 10% of adolescents[33] exhibit the signs and symptoms of PCOS which in addition to obesity include hirsutism (increased body hair), infrequent menses without ovulation, polycystic enlarged ovaries, and tonically elevated circulating levels of estrogen. PCOS resembles closely the MS with additional findings related to increased androgen production. The incidence of MS in adolescent girls with PCOS has been reported to be 37% compared to 5% in control adolescents[34]. Because of the interrelationship of multiple factors, it is unclear whether PCOS causes obesity or results from it in certain vulnerable individuals, but weight control and exercise are the foundation of its management during adolescence as well as adulthood [35] .

Estrogen, Obesity and Pregnancy

Pregnancy is another especially vulnerable time for weight change. The hormonal environment of increased estrogen and progesterone during pregnancy is designed to accumulate and store additional fat for energy needs during pregnancy and lactation.

Hyperandrogenemia in PCOS

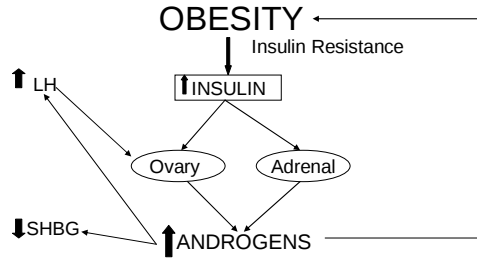


Figure 1.

The optimal weight gain with good nutrition during pregnancy is 25 pounds which accounts for weight gain attributed to the pregnancy itself. Thus by 6 weeks after delivery weight should be that of the pre-pregnancy weight. The obesity that is present for many women at middle age was begun during the childbearing years. Thus, the child bearing years represent an especially good opportunity to prevent later midlife obesity and its attendant comorbidities [36]. On the other hand, attempts at weight loss during a pregnancy are detrimental to mother and fetus.

It is a widely spread misbelieve that oral contraceptive use results in weight gain. Many studies have examined the effect of oral contraceptives on weight gain and found it to be negligible to non-existent [37]. Good nutrition and exercise are required with or without oral contraceptive use to maintain a healthy body mass.

Estrogen, Obesity and Menopause

Estrogens promote, maintain and direct the distribution of adipose tissue throughout the lifespan by yet-to-be described mechanisms. Functional estrogen receptors seem to be lacking in adipose tissue, so that the primary effects are indirect. Estrogen deficiency results in increased adipose tissue, especially in visceral fat in both premenopausal and postmenopausal women [24-25].

Menopause has been shown to be associated with decreased energy expenditure both at rest and during physical exercise. Adipose tissue is preferentially deposited centrally (visceral fat), and there is an increased level

of insulin [38-39]. Furthermore, early menopause is associated with central obesity independent of age and overall adiposity when assessed by CT or MRI [40]. Preservation of the ovaries at the time of hysterectomy is associated with lower long term all cause mortality [41].

Hormone replacement therapy (HRT) following menopause reduces central obesity, IR, new diagnoses of Type 2 diabetes mellitus (DM2), hyperlipidemia, blood pressure, adhesion and procoagulant factors in women without DM and IR and fasting glucose in women with DM. HRT is similarly beneficial in persons with MS. The route of administration of HRT may be of importance. Oral HRT increases the inflammation marker, CRP, and the blood coagulating protein, S. Transdermal administration of estrogen replacement is not associated with the potentially adverse effects [42-43].

Estrogen and Aromatase in Males and Females

Aromatase enzymes in adipose tissue are responsible for most of the estrogen present in males and females after menopause. The aromatase activity is directly related to the amount of adipose tissue present. Aromatases convert androgens from the adrenal glands and in the male, from the testes, into estrogens. Male obesity, especially central obesity, is associated with reduced adrenal and testicular androgen production. This causes a decrease in estrogen production by the adipose tissues and an increased risk profile for glucose intolerance and atherogenic dyslipidemia associated with CVD [39].

Estrogen and Bone Mass

Although the emphasis for improved health is clearly on weight loss or control throughout life other weight related health concerns must be taken into account, especially during weight loss in postmenopausal women. Adipose tissue is the primary source of postmenopausal estrogen. Obesity, therefore, decreases the risk of bone loss and the resultant osteoporosis after menopause. Thus weight loss may increase the risk of bone loss and fracture. Weight loss should be carefully monitored and be part of an overall plan including increased exercise, calcium and vitamin D intake, bone density determination and pharmacologic bone formation treatment where indicated [44-45].

Estrogen, Obesity and Breast Cancer

No discussion about estrogen and obesity would be complete without a consideration of the relationship between these 2 factors and breast cancer. Obesity increases the risk of a variety of cancers including breast, prostate, endometrial, colon, and gallbladder. The association is related to the hormonal environment found in obese persons [46].

As mentioned earlier, weak adrenal androgens are converted to estrogen in adipose tissue—the greater the amount of adipose tissue, the greater the amount of estrogens produced. This conversion is brought about by the action of the enzyme, aromatase in the stroma of adipose tissue. The majority of breast cancers are estrogen dependent and contain specific cellular receptors for estrogen. Thus, reducing obesity lowers the estrogen produced by the adipose tissue, reducing the risk of breast cancer as well as the other cancers listed above.

The increased risk of developing breast cancer in obese persons far exceeds that due to hormone replacement therapy in the menopause [47]. The large Women's Health Initiative (WHI) study relating breast cancer to hormone replacement therapy used overweight or obese subjects for their study groups. HRT did not further increase these subjects' risk of breast cancer above what obesity already did. Since upper abdominal obesity is associated with increased insulin resistance which is associated with an increased risk of breast cancer as well as CVD, obesity is likely to be the primary risk factor for both breast cancer and CVD rather than HRT as suggested in the WHI. Furthermore, low dose estrogen replacement begun early in the menopause may actually decrease the risk of breast cancer development, secondary to its effect on decreasing upper abdominal adiposity and IR. Breast cancer risk is higher in persons with general obesity and is still further increased in the presence of upper abdominal adiposity [48]. Women with increased androgen levels after menopause, have higher circulating levels of free, biologically active estrogens due to the decreased binding of circulating estrogen by sex hormone binding globulin (SHBG). PCOS patients have yet an additional risk for breast cancer due to this factor [49].

As a result the stimulation of breast cancer cells by estrogen, factors that reduce estrogen levels or the bioavailability of estrogen decrease the risk of cancer and provide treatment opportunities when cancer has developed. Aromatase inhibitors such as letrozole and estrogen receptor blockers such as Tamoxifen and Raloxifene [50] have been successful chemotherapeutic agents in the treatment of breast cancer and the prevention its recurrence.

Phytoestrogens, weak estrogens found in many plants and especially high in soy products, may well play a role in reducing breast cancer risk by mechanism similar to Tamoxifen and Raloxifene [51].

The hormone estrogen is involved in many different ways in the presentation of obesity. Researchers are investigating the relationship of estrogen to NEAT. Data indicate that elevated NEAT levels may be protective against weight gain—persons with higher NEAT are less prone to obesity[2]. Reducing bioactive adipose tissue will reduce estrogen production in pre-pubescent overweight females, females with PCOS, and overweight males. Increase NEAT levels may directly and indirectly affect estrogen influence on obesity.

Adipokines and Obesity

Adipocytes are fat cells. There are two types of adipocytes: white and brown. Adipocytes are bioactive cells that have endocrine and secretory functions. White adipose tissue (WAT) releases a wide range of proteins, factors and chemical signals termed adipokines¹. Adipokines are a group of 30 or more peptides which are involved with the chronic inflammatory state of central obesity [52-53]. Understanding inflammation and reducing levels of tissue inflammation represents a major area of current investigation in the treatment of the obesity related morbidities of DM2, CVD, and endocrine related cancers.

Adiponectin is an adipokine protein secreted exclusively by WAT and present in human plasma. Elevated levels of adiponectin are associated with lower body mass index (BMI); conversely low levels of adiponectin are associated with high BMI or obesity and IR. Adiponectin is the only reported adipokine that is not inflammation causing but rather has anti-inflammatory effects on tissues.

Adiponectin biological effects increase insulin sensitivity, fatty acid oxidation and energy expenditure, and reduce gluconeogenesis (the production of glucose from storage forms in the liver [54]. WAT expresses the genes encoding for adiponectin. The lower WAT the higher adiponectin levels noted in the plasma. Adiponectin production is decreased proportionate to the amount of visceral fat[55].

Adiponectin is anti-atherogenic, improving endothelial function by its anti-inflammatory effects on the vascular walls [56]. The anti-inflammatory and insulin sensitizing effects of adiponectin are decreased with central obesity

while at the same time the pro-inflammatory and insulin resistance properties of other adipokines are increased with central obesity [57]. Weight loss in obese persons decreases the inflammatory state as determined by C-reactive protein (C-RP) levels and also increases adiponectin production [58].

Low levels of adiponectin associated with central adiposity is implicated in non-alcoholic fatty liver disease and steatohepatitis. These two co-morbidities of obesity can lead to liver failure. Adiponectin production is decreased in persons with PCOS even after controlling for BMI [33].

Weight loss is highly effective in reducing the long term effects these and other obesity related co-morbidities, in part through increasing adiponectin production [59]. In a study by Yang et al., 2001 a 21% reduction in BMI resulted in 46% increase in adiponectin production [60]. Addressing total energy expenditure exercise and non-exercise activity thermogenesis may decrease central adiposity and increase adiponectin production.

Hormones and Nutrient Absorption

Nutrients in food are chemical substances that provide energy for body processes as well as building blocks for growth and repair. Major classes of nutrients are carbohydrates, proteins and lipids along with smaller quantities of minerals and vitamins. Though water is not a nutrient per se, everything in the body is mediated in the presence of water. We get nutrients from the food that we eat. Food is digested in gastro-intestinal tract (GIT). During digestion, large nutrient molecules are broken down into smaller units so that they may be absorbed from the GIT. Nutrients absorbed from gastrointestinal tract are processed initially in the liver and elsewhere later on. Ultimately, nutrients are made available to cells as and when required. Glucose is the most common, smallest unit of carbohydrate absorbed from the GIT. Glucose is the primary source of energy and the brain must be continuously supplied with glucose. Blood glucose levels are normally maintained within a narrow range of 70-110 mg/100 ml of blood. The absorbed glucose that is in excess of what is required to meet the temporary needs must be stored and released as needed till the next meal. Excess glucose may be stored in liver and muscle as glycogen. Only a limited quantity of glucose can be stored in liver and muscle as glycogen. Maximum of a day's worth of glycogen may be stored this way. Any excess glucose may be stored as triglycerides in adipose tissue. Proteins are the building blocks used for growth and repair. Excess proteins along with lipids also are stored as triglycerides in adipose tissues.

Ingestion, digestion, absorption, storage, release from storage and utilization of nutrients is influenced by hormones secreted by traditional endocrine glands and non-traditional endocrine cells such as WAT. Proteins secreted from adipose tissue are increasingly considered to be directly linked to the pathologies associated with obesity, particularly insulin resistance and the metabolic syndrome [1]. In fact, all hormones contribute one way or the other in the management (ingestion, storage, release and utilization) of nutrients. The major hormones involved in the consumption of nutrients are insulin, glucagon, leptin, ghrelin, adiponectin and neuropeptide Y. With the exception of ghrelin, all these peptide have an inhibitory effect on food intake.

Insulin

Insulin is a hypoglycemic hormone; i.e., it tries to lower the blood glucose levels. Insulin tries to lower the blood glucose by increased utilization of glucose and storage of excess glucose as glycogen and triglycerides in adipose tissue. As the absorption of glucose decreases, insulin secretion also tapers off and glucagon begins increasing. Glucagon is the hyperglycemic hormone i.e., it attempts to increase the blood glucose level. Glucagon is secreted by the alpha cells in the islets of Langerhan in pancreas. Glucagon prevents the blood glucose levels from going below a threshold level.

Leptin

The discovery of **leptin** has markedly increased our understanding of the complex physiological system that regulates satiety and eating behavior. Leptin is a protein predominantly produced by WAT making adipose tissue an important endocrine organ.[61] Leptin is an anorexigenic hormone (decreases appetite). Leptin enables maintenance of stable body mass by decreasing appetite and increasing energy expenditure. Inadequate or defective leptin production leads to obesity [62]. Leptin with insulin are the most important components of the long-term signals regulating food intake and energy homeostasis [62].

Insulin can indirectly stimulate leptin secretion from adipose tissue by increasing glucose metabolism. On the other hand, leptin secreted by the adipocyte can inhibit insulin secretion[63]. Both Leptin and insulin may

inhibit food intake and increase energy expenditure by activating the sympathetic nervous system.

Increase levels of leptin in laboratory rats exhibited 30 to 50 percent reduction in food intake, and body fat was absent compared to pair-fed, control rats [64]. Furthermore, plasma triglycerides and insulin levels were significantly lower in hyperleptinemic rats while fatty acid and glucose levels were similar in the 2 groups. This was suggestive of enhanced insulin sensitivity in the hyperleptinemic animals. They also observed possible specific lipotropic activity for leptin. Serum leptin levels are not related to energy expenditure rates suggesting that leptin regulates body fat predominantly by altering eating behavior rather than calorogenesis [64]. In humans leptin secretion is mainly related to glucose metabolism and only secondarily to plasma insulin and glucose [65].

Obesity and Insensitivity to Leptin

Leptin acts in the brain as the afferent signal in a negative feedback loop reporting nutritional information i.e., size of the energy stores. The plasma leptin levels correlate in proportion to adiposity being high in obesity and falling after weight loss [67-68]. These data suggest that, in most cases, human obesity is likely to be associated with insensitivity to leptin. Environmental factors can modulate leptin sensitivity. It is likely that an extended period of exposure of the brain, especially thalamus, to a high level of leptin may result in the development of central leptin resistance [68]. CRP is a major leptin-interacting protein [69]. In vitro studies showed that human CRP directly inhibited the binding of leptin to its receptor and blocked cellular signaling. Infusion of human CRP into ob/ob mice blocked the effects of leptin on satiety and weight reduction, and the actions of human leptin were blunted in mice expressing human CRP. They suggested that the so-called 'leptin-resistance' may be mediated by circulating CRP that binds leptin and attenuates its physiologic functions.

Ghrelin

Ghrelin is a newer peptide hormone primarily secreted by stomach. This is an appetite stimulating hormone. It binds growth hormone secretagogue

receptor and the binding results in increased orexigenic (eating) behavior by producing orexigenic peptides in the hypothalamus[70].

Circulating ghrelin levels sharply increase before and fall after every meal in humans[71]. Whenever there is inadequate supply of energy (negative energy balance), there is an increase in serum ghrelin concentration. Ghrelin influences energy homeostasis predominantly via modulation of central mechanisms. Ghrelin increases food intake through the stimulation of ghrelin receptors on hypothalamic neuropeptide-Y expressing neurons and agouti-related protein expressing neurons[72].

However, since ghrelin returns toward the baseline levels with stabilization of energy balance and or the increase in weight, ghrelin is unlikely to regulate the long-term energy balance[73]. Ghrelin can inhibit insulin secretion[74]. Lower ghrelin levels were associated with higher prevalence of metabolic syndrome. Progressively lower ghrelin levels was associated with an increasing number of the parameters of metabolic syndrome[75].

Thus two peripherally produced hormones, ghrelin a peripheral orexigen and leptin a peripheral anorexigen, exert opposite effects on specific hypothalamic neuronal populations and play a key role in regulating energy intake and output[76-77]. Ghrelin and leptin appear to impose opposite effects on arcuate neuropeptide Y (NYP) neurons.

Central Nervous System and Endocrine Effects on Energy

The central nervous system in general and the hypothalamus in particular is where signals from both the external and internal environment are integrated and adjustments made to maintain the homeostasis of vital functions. There is no function more important to the well being of the body than the control of energy supply and demand. Similarly dysfunction of this homeostatic regulation has far reaching effects on the body as a whole resulting in the development of CVD, DM2, and cancer.

Energy homeostasis is achieved through the integration in the central nervous system of nutrition, neuronal and endocrine signals. The hypothalamus is the primary generator of the sensations of hunger and satiety, and the signals to the body of the state of energy stores and availability [78]. Many messenger molecules communicate between the hypothalamus and the energy acquiring, storing, and release systems of the body. Leptin, originating in the adipose tissue, is the mandatory afferent signal which maintains weight

homeostasis under normal conditions[79]. When this signal is chronically diminished by dietary excess of energy dense foods and decreased energy expenditure, unregulated fat accrual occurs and the attendant morbidities of obesity.

Ghrelin is a small peptide produced by the stomach. It acts through the ventral tegmental area of the brain to increase hunger and food intake. It also binds to growth hormone receptors throughout the central nervous system in areas associated with goal directed behavior [80]. Other signals from the GI tract, transmitted by the vagus nerve, act upon the brain stem influencing the timing and amount of food ingested [81]. One of the mechanisms by which leptin decreases appetite is by increasing the sensitivity of the brain to these intestinal signals, especially in the arcuate nucleus of the hypothalamus which is the primary site of leptin signaling.

The hypothalamus, as with other regions of the brain, develops during intrauterine and early extrauterine life. This development consists of the formation of new cells, their migration to final sites, and the functional neural connections operative during the rest of life. Maternal obesity and early childhood obesity are risk factors for long-term obesity and its co-morbidities in adolescent and later adulthood. Efforts directed toward providing a healthy nutritional environment during this crucial period of brain development offer an ideal preventative opportunity [81].

Growth hormone (GH) from the pituitary gland is very important in the regulation of linear growth through the completion of pubertal development. Adults with GH deficiency have an increase in fat accumulation and changes in lipid metabolism, increasing their risk of CVD [82]. GH replacement reverses these changes. Abdominal obesity is associated with a reduction in GH secretion which is reversed with weight loss. The physiological mechanisms involved in GH secretion in the adult are yet to be described.

Many areas of the brain other than the hypothalamus including the cortex, basal ganglia, and limbic systems are involved in energy balance. These systems have evolved to insure sufficient food for the immediate as well as the longer term energy needs which may include periods of famine and competitive needs for food exceeding that which was readily available. Through genetics, imprinting, learning and memory, powerful emotions are present to insure an adequate food supply and the ingestion thereof from a sparse and often hostile environment [83-84].

The developed world provides easy availability for large quantities of energy rich foods along with strongly influencing food cues, low cost and a more and more sedentary life style. The brain centers controlling emotion and

behavior relative to food intake are simply overcome by the abundance of food and food cues coupled with lifestyles requiring little energy expenditure. These behavioral central nervous system components are as physiological as the metabolic regulatory centers, yet they have received inadequate attention and study. The first line of defense in the prevention and treatment of obesity and its co-morbidities lies in altering lifestyle such as increasing the level of NEAT.

Summary

Obesity as a health condition needs further elucidation. The endocrine processes are the chemical messengers involved in sustaining the biological systems essential for life. In the human body nutrition and nutrient intake, storage, and utilization is critical for sustaining life. In the history of the human race, where food was limited and work energy abundant, starvation was guarded against through neuroendocrine mechanisms. Those same mechanisms remain in our human selves despite the fact that food is plentiful today and work energy is markedly reduced through modern conveniences. Preventing obesity and managing weight control through restricted calorie intake and by increasing basal metabolic rate through exercise that promotes negative energy balance is not a simple solution to the obesity epidemic. Research indicates that the onset of obesity and the factors involved in weight control across the life span are multi-factorial. The complexity of what would seem to be a simple equation regarding calorogenic function and exercise and the desired negative balance is being investigated in many ways including the relationship to NEAT, insulin resistance, leptin resistance, ghrelin, WAT and BAT and the role of estrogen. As the global epidemic of obesity continues to expand, the need for scientific, medical, and health advances in the study of obesity and health knowledge regarding the co-morbidities associated with obesity is essential. Advancement in pharmacotherapeutics, exercise science, and nutrition for the prevention and treatment of persons who are obese requires further understanding of the neuroendocrine system that appears to control satiety, hunger, basal metabolic rate, and human emotion regarding food.

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Chapter III

Consideration for Muscle Strength Measurement

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Abstract

Sufficient muscle strength is one of the essential components for normal movement production and control, and is determined by many factors such as muscle cross-sectional areas, muscle fiber type compositions and muscle architectures. This chapter focuses on three other aspects that influence the strength performance of subjects with or without injury. Firstly, the strength will be influenced by anthropometric variables, especial the fat composition. Evidence shows that the strength difference between genders is largely affected by the difference in fat composition. While the fat composition covariate is controlled, the effects of gender on strength then become not significant. Secondly, the strength measurement results will be misleading if the measuring method is unreliable. In studies of investigating the reliability of isokinetic knee strength and the isometric hip and knee strength by handheld

dynamometer, it was found consistently that the testing position is crucial to improve the reliability; changing the testing position from the traditional prone to prone-standing for hip extensor strength could effectively improve the strength measurement reliability. With the provision of the relative and absolute reliability, we could also know which measurement methods are reliable, and more clinically useful, how much the strength increasing could indicate a real improvement for a single individual. Finally, the recovery of strength deficits after incidents such as ACL rupture or reconstruction should be carefully monitored, as evidence shows bilateral weakness may exist after an unilateral injury, and the weakness of the affected knees may even exacerbate early after the reconstruction procedures. Evidence also shows that part of the strength insufficiency could be explained by muscle recruitment failure. Therefore, a holistic investigation upon strength performance including understanding the body composition, measuring the extent of weakness and voluntary activation, with carefully selected procedures, should be necessary for designing an effective strengthening program.

Introduction

There are about 650 skeletal muscles in the human body. Skeletal muscles are made of fibers that enable them to shorten and lengthen, which then produces force and allows movements to occur. Muscle strength is one of the major components of physical fitness and motor function. How to make a reliable measurement of muscle strength is therefore important for interpretation of physical function. Factors affecting muscle strength such as type of muscle fibers, gender, body size, muscle length and girth, point of tendon insertion are inherited. Apart from that, muscle strength can also be affected by training or disuse, disease or injury, and growth and ageing. This chapter will discuss the anthropometric factors influencing muscle strength, the reliability of muscle strength measurement, and strength deficits after ACL injury as an example of negative impact on muscle strength with sports injury.

Influence of Anthropometric Variables

Muscle strength will be influenced by many factors, such as anthropometric properties, gender, training, and ageing [1-10]. Men have significantly larger strength than women, trained subjects have larger strength than untrained subjects, and in adults, the strength will decline with age. The

body weight and height are commonly suggested to be the best predictors of general muscle strength [11-13]. In this chapter we focus on how the body composition and gender influence the leg muscle strength.

In a study investigating knee isokinetic strength and body fat composition, the knee isokinetic strength, multiple anthropometric properties and body composition of 58 university students without previous knee injury were measured [14]. The isokinetic strength of knee flexion and extension was measured in fast ($120^{\circ}/\text{sec}$) and slow ($60^{\circ}/\text{sec}$) speeds. The anthropometric properties measured including the height, weight, body mass index (BMI), and waist and hip girths ratio. The percent of body fat (FAT%) was calculated with the bioelectrical impedance analysis (BIA) and also from the calculation of four sides of skinfold (biceps, triceps, subscapularis and suprailiac). The fat free mass (unit: kilogram) was also estimated from the BIA machine. The study found both knee extension and flexion strength were correlated with the anthropometric properties and body composition, with the range of values of correlation coefficient between 0.35 - 0.78, which was regarded as moderate to high correlation according to Campbell et al. (who recommended that the value of correlation coefficient over 0.6 could be considered as highly correlated, and the value between 0.3 - 0.59 as moderately correlated) [15]. Table 1 showed the correlation coefficient of strength with multiple factors in this study. Among these factors, the best predictor for knee strength was fat free mass (in kilogram) which was highly and positively correlated with all type of isokinetic strength. The FAT% measured by BIA was also considered as a very good predictor, with highly negative correlation with all types of isokinetic strength measured. However, the FAT% estimated from calculation of skinfold was only moderately correlated with the all types of knee isokinetic strength measured. Considering the possible reasons, the skinfold method for calculating the FAT% may be less reliable, and the FAT% may only demonstrated the fat distribution underling the skin but unable to show the FAT% of the whole body. In particular, the intramuscular fat tissue is not measured at all. For the anthropometric properties, the weight seems to be the best predictor, and the waist and hip girths ratio was the poorest predictor for the knee strength. Therefore, FAT% can be a very good muscle strength predictor with a good measurement method, and for those with same body weight, strength can be predicted with FAT%, the lower the FAT%, the higher muscle strength can be expected. As to the gender factors, the study definitely found man is stronger than woman. However, after co-variables such as FAT% by BIA and BMI was controlled, difference in muscle strength between man and woman became non-significant.

Table 1. The correlation between the knee isokinetic strength and anthropometric properties

	Slow speed		Fast speed	
	Extension	Flexion	Extension	Flexion
Height	0.60	0.64	0.58	0.50
Weight	0.62	0.68	0.51	0.51
BMI	0.51	0.55	0.36	0.42
W/H	0.44	0.52	0.35	0.44
Fat% by skinfold	-0.48	-0.42	-0.56	-0.49
Fat% by BIA	-0.68	-0.60	-0.74	-0.64
Fat free mass	0.75	0.78	0.68	0.64

Slow speed: 60°/sec

Fast speed: 120°/sec

BMI: body mass index

W/H: The ratio of the waist width to height

BIA: bioelectrical impedance analysis

Reliability of Strength Measurement

The strength measurement results will be misleading if the measuring method is unreliable. A reliable measure of muscle strength is essential to document muscle performance and to detect the changes or difference after injury or training. Moreover, large measurement error of muscle strength can lead to misinterpretation of muscle performance such as over-estimation of training results. The common research methods for reliability study include testing the intra-test reliability, test-retest reliability, and inter-rater reliability. For intra-test reliability, a subject is repeated a number of measured from the same rater within a short time interval. For test-retest reliability of muscle strength measurement, the subject is tested twice from the same rater with a longer time interval (at least days), for the reason of preventing the effect of fatigue from the first testing [16-19]. For inter-rater reliability, subject is tested twice (or more) by two (or more) different raters. Although the inter-rater reliability could be tested by two raters immediately, it should be done with caution as the subjects and the raters could also be fatigued in second test. Better time arrangement is necessary to avoid fatigue of the subjects and the raters when repeated measurement is taken.

Several statistical methods and indices have been proposed to examine the reliability of muscle strength measurement, it is suggested that both the relative and absolute reliability should be assessed [20-22]. For relative reliability, Pearson's r and intraclass correlation coefficient (ICC) are most commonly used. However, using Pearson's r for reliability study has obvious disadvantages. The Pearson's r assesses the strength of relation between two sets of measurements, not the agreement of two sets, while ICC shows the level of agreement among tests. For example, if a rater recorded the strength values from 5 subjects as 5, 6, 7, 8 and 9, but another rater recorded the strength values from the same 5 subjects as 10, 12, 14, 16 and 18, the value of Pearson's r for assessing the inter-rater reliability will be 1, it demonstrates that the reliability is perfect, however, the agreement of two test is actually very poor. Therefore, using Pearson's r to assess the reliability is not recommended. Moreover, the ICC is calculated as the ratio for the variance between subjects and the total variance. A good test should show high ICC; Fleiss suggests the values of ICC over 0.75 indicating excellent reliability [23]. However, there are still some limitations for the ICC, as the ICC does not provide the details of measurement error [24].

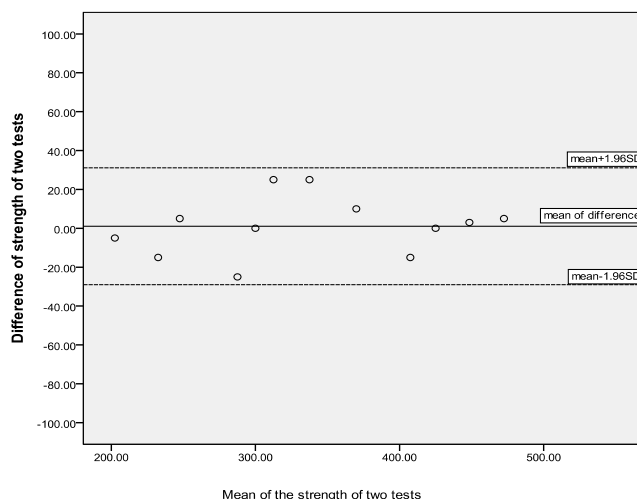
The absolute reliability, the standard error of measurement (SEM) and the smallest real difference (SRD) can be used to determine the extent of measurement error [25-26]. A good test should demonstrate small SEM and SRD. The most important clinical implication is the absolute reliability (SEM and SRD) expressed in the same units as the measurement. For example, if the strength is measured in Nm, the dimension of the SEM or SRD is in Nm. It can let us know the value of measurement error of this test, therefore the change within the value is only the measurement error, and the change beyond the value is the real change. The SEM is calculated by the following formula: $SEM = SD \sqrt{1-ICC}$. It can be used to compare the mean difference between groups. The SRD can determine the extent of measurement error with a 95% confidence level (27-28), which provides useful information pertaining to the actual value for real change for individuals. The SRD is calculated by the following formula: $SRD = 1.96 \times SEM \times \sqrt{2}$. The strength for each person may show large variation, therefore for easier interpretation, the SRD% can be obtained by dividing the SRD by the mean of each strength measurement results and then multiplying by 100. Using the SRD% as an indicator, the percentage of increase in the strength over the SRD% can demonstrate a real change for a person after intervention or training. The strength measurement may have systematic bias, such as the learning effects in second test, insufficient recovery of fatigue between tests, or inconsistencies in the

measurement methods. The systematic bias can be assessed with the Bland and Altman analyses and paired t-tests. Bland and Altman plot provides a visual interpretation, in which the difference between two tests is plotted against the mean of the strength for each subject (Figure 1). A test with good reliability should show a mean difference closing to zero; a large mean difference implying systemic bias may exist between the two tests. The 95% limits of agreement (LOA) can also be showed in the plot which indicating the range of the mean difference ± 1.96 SD of the difference. We could easy understand the difference between tests by visual analysis from the LOA; the smaller the range, the better the test stability.

Isokinetic dynamometry has been considered to be the gold standard for assessing dynamic muscle strength. The isokinetic dynamometry could provide many information of various muscle performance characteristics. Although studies have shown the isokinetic dynamometry with good reliability [29-31] the instrument is very expensive, inconvenient and limited in application for different setting. The hand-held dynamometer (HHD) is a cheaper alternative for isokinetic dynamometry, more convenient and suitable for different setting in clinical application. For using the HHD, the rater holds the device with hand and presses it against the force that subject exert with a maximal effort. The make test and break test are two measurement techniques for HHD. In the make test, the rater resists the subject's maximal isometric contraction, whereas in the break test the rater overcomes the force of the subject produced in eccentric contraction [32-33]. Both methods have their advantage and disadvantages. The strength measured by the break method will be higher than that of the make method. The muscle strength taken from a break test were found at least 1.06 times than a make test [34-35]. To measure the maximal strength of strong muscles such as the hip and knee, we suggest using the break method, as the strength assessed by this method may more close to the subject's maximal effort. However, it is difficult to do a break test on an already-strong muscle such as muscles in the lower extremities when the force of rater is not compatible to than the subject.

The reliability of HHD measuring the lower extremities varies due to some factors. It depends on different measuring methods, testing positions and area of the body measured. The reliability of hip abduction and adduction were the better when measured with long-level arm [19]. Influence of the testing position on the inter-rater reliability was founded of hip extensor strength. The study compared two testing positions for assessing the reliability for hip extensor strength, the ICC value was improved from 0.65 to 0.92, from prone to prone standing [17].

A.



B.

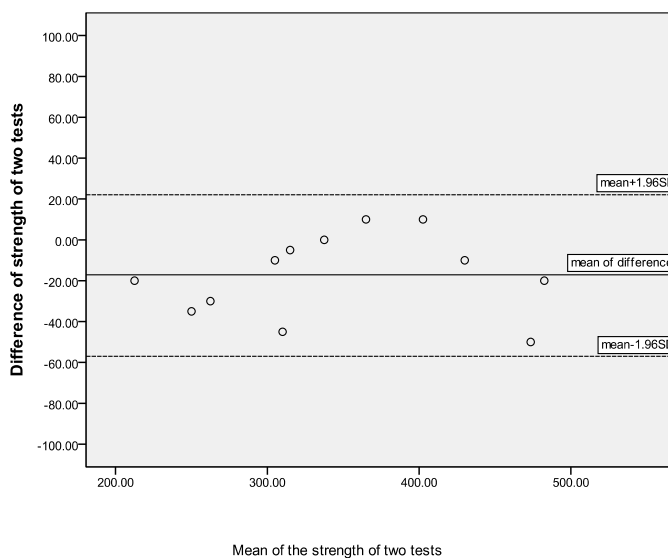


Figure 1. An example of the Bland-Altman plot, the differences between measures from the two test sessions against the mean of the two sessions for each subject. The dash line shows (± 1.96 SD) limits of agreement. (A) Mean difference is closed to zero, and the limits of agreement is small between the two tests (B) A systemic bias between the two tests, one is larger than the other, and the limits of agreement is large between the two tests.

In prone position (PP), the subjects were asked to lie prone on a height-adjustable table, which is the traditional method for assessing hip extensor strength. Another position was prone standing position (PSP), subjects stood and leaned forward on the height adjustable table and the trunk was supported by the table and the standing leg while the other leg was tested. The results found the interrater reliability was excellent in PSP; the relative reliability, ICCs, were 0.92 in PSP and 0.65 in PP. For absolute reliability, PSP has much lower SRD% (8.4%) than PP (20.8%). Therefore, changing the testing position from the traditional prone to prone standing position effectively improved both the relative and absolute reliability.

Reliability of measurement of strong muscles with HHD is still a problem. For example, muscles as strong as knee extensor can cause problem in a break test. Lu et al. studied the reliability of hip and knee muscle strength by break test on normal adult subjects [36]. The results showed that the relative reliabilities of hip flexors, hip extensors, and hip abductors were excellent (ICC were 0.83, 0.92 and 0.89 respectively) for inter-rater reliability. However in the knee joint, only the knee flexor showed an excellent reliability (ICC = 0.89), and the knee extensor poor reliability (ICC = 0.60). Furthermore, the values of SEM% of hip joint were only 5.7%, 2.1%, and 3.3% for hip flexors, extensors and abductors. The values of SRD% of hip joint were 15.8%, 8.4%, and 9.1% for hip flexors, extensors and abductors. The values of SEM% of knee flexor was only 6.3%, for extensor was 8.2% and the values of SRD% of knee flexor was 17.4%, for knee extensor was 22.8%. It indicates that if the purpose of a study is to exam the effects of intervention or training on the strength performance, the percentage of the strength change should be greater than 5.7%, 2.1%, 3.3%, 6.3% and 8.2% for hip flexors, extensors, abductors and knee flexor and extensor respectively. If the mean strength of a group improves below the SEM (or the percentage of the strength below the SEM%), the increased strength may only within the measurement error, not really a change. For clinical practice, to determine the effect of muscle training for a single subject, the percentage of strength increase should be higher than SRD% to indicate a real improvement. For hip and knee muscles, this study suggests the percentage of strength increase should over 15.8%, 8.4%, 9.1% for hip flexors, extensors and abductors and 17.4% and 22.8% for knee flexor and extensor. Therefore, when measuring the knee extensor strength by different raters, there is higher variation with low agreement and large measurement error. Furthermore, this study also found the measurement of knee extensor strength demonstrating systemic bias between raters. The one of the raters seemed to produce higher measurement results. The knee extensor

strength is measured very frequently in clinical routines. Therefore, how to improve the reliability of knee extensor strength by HHD still has room to improve.

Strength Deficits after ACL Injury and Reconstruction

Sufficient muscle strength is one of the most important contributors to good exercise performance. However, many sports injuries inevitably lead to damages in joints, ligaments or muscles which subsequently reduce the motor performance and muscle strength. For example, rupture of the anterior cruciate ligament (ACL) is one of the most common sports injuries of the knees which compromises the knee strength to a great extent. Despite the advances in sports medicine and surgery, knee muscle weakness continues to be a difficult complication after ACL deficiency and reconstruction [37-40]. The consequences of a weak and unstable knee can cause not only imbalance and limited functional activities in the short term, but also lead to faulty compensatory mechanism in the lower extremity and arthritic changes prematurely [41-49]. It has also been documented that bilateral muscle changes occurred after a unilateral ACL injury [50-53]. These effects can be a huge and lasting impact, and very disabling, since most of the victims are in their mid-twenties or early thirties, many of them active participants in sports.

When weakness does occur, early recognition and appropriate treatment can be expected to restore better knee motion and optimize function in most ACL deficient clients [54-57]. Thigh muscle strengthening is the main component of the rehabilitation program after ACL injury. In the traditional training protocol, quadriceps strengthening is aiming for strength return and hamstrings is targeted for better knee stability [58-61]. Thigh muscle strengthening after ACL reconstruction is said to be effective; as strength is increased in the operated leg after surgical repair, functional performance and knee stability may also improve [37, 62-67]. However, there is also evidence showing that the improvement in function and agility is limited, even with extensive strengthening [38, 41, 53, 68-69]. It may also take as long as 5 years to restore the strength similar to the non-injured knees [70]. Effect of training also varies according to the delay to surgery, type of reconstruction, or rehabilitation protocol [42, 54-55, 71-74].

Although most of the existing evidence from surgical and rehabilitation perspectives seems positive, there is still inadequate information concerning the form or extent of strengthening exercise, and little is known about the influence on the reflexive linkage between knee ligaments and muscles [75-78]. Even biomechanically these grafts seem to function well, it is still important to explore the immediate and long-term physiological changes in muscle strength of the knee region. Therefore, strength investigation with reliable measurement methods of such injury and recovery should take into consideration of all aspects relevant to muscle recruitment and including them in the training program.

Conclusion

The major conclusions are:

1. The fat free mass and the FAT% are the best two predictors of muscles. The gender difference in muscle strength is diminished when FAT% and BMI is controlled.
2. The SRD of a strength measurement can be used to determine the extent of measurement error, and the SRD% can be used as an indicator of a real difference in the strength measurement for a single subject.
3. With HHD, the break method is recommended to be used in measuring muscle strength as the strength assessed by this method is closer to the subject's maximal effort. However, for very strong muscle groups such as knee extensors, it is need to be cautious that there is higher variation with low agreement and large measurement error in measuring this way.
4. The deficits and recovery of muscle strength after sports injuries such as ACL injury can be devastating. Careful and long-term monitoring of the recovery of muscle strength with reliable methods is crucial in a ACL rehabilitation program. Although the evidence of rehabilitation training seems positive, it may take years to recover with sometimes less satisfactory outcomes.

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Chapter IV

Determinants of Physical Health among Pregnant Women in Macao, China

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Abstract

Objective: to identify the relationship of demographic, socioeconomic and obstetric variables and perceived stress on physical health among Macao Chinese pregnant women.

Design: a cross-sectional and exploratory quantitative study

Settings: an antenatal clinic of a university-affiliated regional public hospital in Macao.

Participants: a community-based sample (n=717) pregnant women in the second trimester

Measurements: perceived stress was measured by the Perceived Stress Scale (PSS), and Physical Health was measured by the standard SF-12 Health Survey (SF-12).

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Findings: a multiple linear regression analysis revealed that pregnant women who were secondary or lower education attainment ($\beta = .105$, $p = 0.013$), had better interpersonal relationship with family members ($\beta = 0.108$, $p = 0.014$) who lived in bigger residence size ($\beta = 0.085$, $p = 0.041$) without obstetric complications ($\beta = 0.085$, $p = 0.026$) and perceived lower stress level ($\beta = -0.096$, $p = 0.017$) had better physical health among Macao pregnant women.

Conclusion: preliminary information was provided about Macao Pregnant women who had better physical health during pregnancy that was associated with the demographic, socioeconomic, obstetric, and perceived stress variables.

Implications for practice: the development of a checklist or structured questions was necessary for clinical situations and tailor-made a program of enhancement of physical health during pregnancy.

Keywords: Physical Health; Perceived stress; Pregnancy; Macao

Introduction

Pregnancy is a common event for women of reproductive age and is generally viewed as a time of excitement, anticipation, and uncertainty, however, it is also characterized by significant changes in the functioning of a woman's body (Sieber, Germann, Barbir, and Ehlert, 2006). The physical changes accompanying pregnancy affect all major body systems and commonly expressed as physical symptoms (Kamysheva, Wertheim, Skouteris, Paxton, and Milgrom, 2009; Lacasse, Rey, Ferreira, Morin, and Berard, 2008). It included fatigue, nausea, vomiting, heartburn, leg cramps, hemorrhoids, and shortness of breath, many of which are unpleasant and have potentially negative effects on women's lives during pregnancy (Gabbe, Niebyl, and Simpson, 2007; Kamysheva et al., 2009). As a consequence, the perception of physical health may change during the pregnancy period (Tasdenir, Balci, and Gunay, 2010). Previous studies found that physical health was lower in pregnant than in non-pregnant and past-year pregnant women (Mota, Cox, Enns, Calhoun, and Sareen, 2008; Tasdenir et al., 2010). Women experience lower health-related quality of life during pregnancy, particularly in the physical domains (Da Costa et al., 2010). One study also found that the role limitation due to physical health problems was the lowest during the pregnancy compared to other health subscales (Thorell, Svardsudd, Andersson, and Kristiansson, 2010). Similar decreases in physical functioning

and vitality during pregnancy have been reported in another study (Haas et al., 2005). Although these studies show that physical health is a significant risk factor, not all pregnant women who report poor physical health. This raises the question of the determinants of vulnerability in the context of physical health among pregnant women.

Determinants of Physical Health During Pregnancy

Health-related quality of life (HRQL) is a useful concept to measure experienced health state. It has become recognized and established as an outcome variable and health status indicator in medical and public research (Mautner et al., 2009). Various definitions of HRQL agree on a physical, a social, and a psychological dimension. In addition to these dimensions, HRQL is also generally understood to include illness or treatment as well as the appreciation of the personal, subjective nature of a woman's HRQL (Halkoaho et al., 2010). Physiological changes that occur in pregnancy likely contribute to the declines in physical health status (Mota et al., 2008; Setse et al., 2009). In the limited western literature, educational level (Da Costa et al., 2010), relationship with family members (Nohara and Miyagi, 2009), housing circumstances (Jia, Moriarty, and Kanarek, 2009; Kyle and Dunn, 2008), obstetric complications (Mautner et al., 2009) have been found to be associated with physical health among pregnant population. However, the applicability of these findings to Chinese populations is unknown and some findings were mixed (Halkoaho et al., 2010; Mautner et al., 2009). To achieve effective physical health promotion, knowledge is needed of the factors that influence the physical health during a healthy pregnancy, including those that might play an important role in protecting the pregnant women and her unborn child.

Perceived Stress and Physical Health During Pregnancy

Stress is an integral part of life and it can serve as motivation or, in excess, interfere with daily performance, sleep, appetite and mood (Canals-Gonzales, Kranz, Granberry, and Tanguma, 2008). Research suggests that a strong

positive relationship exists between stress and the acceptance of pregnancy and the baby, and preparing for labor and parenthood (Pillitteri, 2009), adverse birth outcomes (Hobel, Goldstein, and Barrett, 2008), and a decrement in mental ability in toddlers aged 14-19 months (Bergman, Sarkar, O'Connor, Modi, and Glover, 2007). Physical health is ambiguous, as multiple factors affect the perception of stress (Pfeifer, Kranz, and Scoggin, 2008). Indeed, the influence of pregnancy on maternal physical health has not been very much studies and data from the relationship between stress perception and physical health among general pregnant women are scare.

Hence, the determinants of physical health among pregnant women in general are not clear. In addition, it is not known whether there are stress perceptions on physical health during pregnancy. An understanding of this relationship is important to design more effective counseling services and treatment programs in both clinical and public health settings. In view of the relatively limited information about determinants of physical health during pregnancy among women in Macao, this is the first study aims to provide an initial picture of the problem with the aim of stimulating further research in the area. Based on the literature review, the following research questions were established.

1. What are the demographic, socioeconomic and obstetric factors associated with physical health?
2. Are women who experience higher levels of perceived stress during pregnancy likely to have poor physical health?

Method

The research design was prospective, cross-sectional, comparative and quantitative. A pilot study with 100 subjects in similar settings was carried out a month before the implementation of the main study to examine the reliability of the questionnaire and the appropriate procedures for recruiting participants. Based on the feedback, some items were revised to improve their clarity, but no changes were made to their original meaning and no item or format among the questionnaire required amendment.

In this study, *physical health* is defined as a pregnant woman's own experience and estimation of a situation, of which physical well-being are the most important components. A higher summary scale score on the standard SF-12 Health Survey (SF-12) (Ware, Kosinski, Turner-Bowker, and Gandek,

2005) represents a better physical health. *Perceived stress* is defined as the appraisal of a pregnant woman of her life as unpredictable, uncontrollable, and overloading. A higher score on the Perceived Stress Scale (PSS)(Cohen, Kamarck, and Mermelstein, 1983) represents higher perceived stress. *Macao Chinese* is defined as people of Chinese ethnic origin who live in the Macao Special Administrative Region, including permanent residents, immigrants, travelers or visitors of Chinese origin.

Measurements

In this study, a questionnaire package contained questions on demographic, socioeconomic and obstetric characteristics based on previous evidence (Da Costa et al., 2010; Jia et al., 2009; Mautner et al., 2009; Nohara and Miyagi, 2009) and two validated measures.

We measured physical health using the standard SF-12 Health Survey (SF-12) with 12 items, which is used to assess physical aspects of quality of life (Ware et al., 2005). The items, which are in the form of questions, explain more than 90% of the variance of the original SF-36. The SF-12 is useful in measuring physical health (PCS 12) without substantial loss of information with four concepts: physical functioning (PF), role physical (RF), bodily pain (BP) and general health (GH). The PCS-12 items include the self-reported assessment of the level of limitation experienced in performing moderate activities, such as climbing stairs, accomplishing less because of the experience of bodily pain and a rating of general health (Ware et al., 2005). A higher score in the respective summary scales represents a higher level of physical health. The reliability and validity tests of the SF-12 have been proven to be satisfactory (Pezzilli, Morselli-Labate, Fantini, Campana, and Corinaldesi, 2007). A Chinese version of the SF-12 survey form with satisfactory content validity was adopted in this study (Lam, Tse, and Gandek, 2005).

The Perceived Stress Scale (PSS) measures the degree to which situations in one's life are appraised as stressful (Cohen et al., 1983). The version we used has 14 items, which were rated on a 5-point Likert-type scale, ranging from 0 (never) to 4 (very frequently). PSS items are designed to tap the degree to which respondents find their lives unpredictable, uncontrollable, and overloading. These three factors have consistently been found to be central components of the experience of stress. Respondents are asked how often in the last month they have experienced specific feelings of stress. Reverse

scoring is used for items describing negative experiences or responses. Total possible scores range from 0 to 56, with higher scores representing higher levels of perceived stress. The internal consistency reliability (Mimura and Griffith, 2004), predictive and concurrent validity (Cohen et al., 1983) and factor structure (Ramirez and Hernandez, 2007) have been found to be satisfactory. A Chinese version of the PSS with satisfactory content validity and reliability (Chu, 2005) was adopted in this study.

Sampling

The research setting was an outpatient clinic in a university-affiliated hospital, S. Januário Hospital, in the Macao Special Administrative Region (SAR). Macao has an area of 29.2 square kilometers, and comprises the Macao Peninsula and the islands of Taipa and Coloane. Macao was a Portuguese colony from the sixteenth century until 1999, and a crossroads between East and West. The total population was estimated to be 549,200 in 2008. About 94% are ethnic Chinese from the provinces of Guangdong and Fujian, and the remaining 6% include Portuguese and others (Macau Government Tourist Office, 2009).

Despite the fact that the recruitment was conducted at this hospital, the sample is nonetheless community based, and it representative of pregnant women in the general population, as all women from different clusters of Macao that covered different demographic and socioeconomic divisions (Macau Health Center, 2004). Assuming the prevalence rate that was found in a previous study (Glynn, Schetter, Wadhwa, and Sandman, 2004) $\pm 1.98\%$ a sample size of 700 would achieve a low error factor (Altman, 2006). This degree of error is approximately a quarter of the size of the prevalence estimate, and it therefore sufficiently small to be used with confidence for planning purposes in the health care service system. A community sampling with a sample size of 717 antenatal women was used, which is considered adequate for the detection of the women. The exclusion criteria included: (1) did not supply written informed consent, (2) carrying an abnormal baby, (3) personal and family history of psychiatric problems, (4) complicated medical problems, (5) severe obstetric complications and (6) being non-Chinese.

Data Collection

Ethical approval that complied with the Declaration of Helsinki was obtained in December 2007 from the Institutional Review Boards of the hospital involved. Convenience sampling of the target population, pregnant Chinese women living in Macao, was adopted. All of the women who attended antenatal clinics within the data collection period of December 2007 to July 2009 were screened and were eligible for entry into the study on the basis of their obstetric record. The investigator then approached the women individually to confirm that those who were eligible had satisfied the selection criteria before they were invited to participate in the study. A full explanation of the study was given and her informed consent was obtained. Data were collected in the second trimester (median = 18 weeks' gestation) because of physiological discomfort (Abel, 2002) and stress level (Hobel et al., 2008) are comparative lower than other trimesters. They completed the self-reported instrument in approximately 10 to 15 minutes while waiting for routine Down's screening program at the antenatal clinic.

Data Analysis

Statistical descriptive analyses of demographic, socioeconomic and obstetric variables and health-related quality of life and perceived stress scores among pregnant women were conducted using the SPSS/PC 16.0 software package. A multiple linear regression model was used to explore the potential variables that influence perceived stress while adjusting for the influence of potential confounders (demographic, socioeconomic and obstetric variables). Linear regression was used to calculate the standardized coefficients (Beta, β) and 95% confidence intervals (CIs) for the unstandardized coefficient (B) to estimate the association between the potential variables and the outcomes of perceived stress level. To prevent multicollinearity among the variables, principal component analysis was performed with a collinearity diagnostics test (Stine, 1995). The variance inflation factor (VIF) was used to analyze the magnitude of multicollinearity, with $VIF < 5$ set as the acceptable level (O'Brien, 2007). The coefficient of determination, R^2 (explained variance), was used to assess the goodness of fit of the multiple linear regression model (Cohen and Cohen, 2003). A p -value of < 0.05 was considered to be statistically significant.

Findings

Nine hundred women were invited to join the study, of whom 183 chose not to participate. The primary reasons for refusal were busyness, tiredness and reluctance to disclose information. The remaining 717 women (response rate = 79.7%) completed the questionnaire. The demographic and socioeconomic characteristics of the women who refused to participate and those of participants were not significantly different. Table 1 shows the demographic, socioeconomic and obstetric characteristics, health-related quality of life and perceived stress of the participants.

Table 1 Demographic, socio-economic, obstetric and perceived stress scale of the participants among better and poor groups (n=717)

Demographic and Socio-economic characteristics		N (%)
Age	> 25	501 (69.9)
	≤ 25	216 (30.1)
Marital status	Married	649 (90.5)
	Single/divorced/separated/ cohabited	68 (9.5)
Educational level	> Secondary	308 (43.0)
	≤ Secondary	409 (57.0)
Family medical history	No	413 (57.6)
	Yes	304 (42.4)
Personal medical past history	No	574 (80.1)
	Yes	143 (19.9)
Personal medical diseases	No	645 (90.0)
	Yes	72 (10.0)
Allergy history	No	652 (90.9)
	Yes	65 (9.1)
Smoking history	No	616 (85.9)
	Yes	101 (14.1)
Alcoholic abuse history	No	647 (90.2)
	Yes	70 (9.8)
Substance abuse history	No	710 (99.0)
	Yes	7 (1.0)
Chronic medication	No	704 (98.2)
	Yes	13 (1.8)
Second hand smoking history	No	330 (46.0)

Demographic and Socio-economic characteristics		N (%)
Smoking during pregnancy	Yes	387 (54.0)
	No	708 (98.7)
Alcoholic abuse during pregnancy	Yes	9 (1.3)
	No	715 (99.7)
Second hand smoking during pregnancy	Yes	2 (0.3)
	No	371 (51.7)
Live in extended family	Yes	346 (48.3)
	No	574 (80.1)
Relationship with family members	Yes	143 (19.9)
	Good to very good	575 (80.2)
Occupational status	Very bad to fair	142 (19.8)
	Full-time / self-employed	554 (77.3)
	Housewife / part time / unemployed	163 (22.7)
Daily working hours	≤ 10 hours	698 (97.4)
	> 10 hours	19 (2.6)
Monthly income ^{\$}	≤ MOP\$10000	434 (60.5)
	> MOP\$10000	283 (39.5)
Partner's monthly income ^{\$}	≤ MOP\$10000	511 (71.3)
	> MOP\$10000	206 (28.7)
Family total monthly income ^{\$}	≤ MOP\$10000	609 (84.9)
	> MOP\$10000	108 (15.1)
Size of residence [*]	> 500 ft ²	523 (72.9)
	≤ 500 ft ²	194 (27.1)
Demographic and Socio-economic characteristics		N (%)
Number of rooms	> one bed room	668 (93.2)
	≤ one bed room	49 (6.8)
Types of residence	Owned house / private house	513 (71.5)
	Rented / social/ economic house	204 (28.5)

Table 1. (Continued)

Obstetric characteristics		
Chronic medication during pregnancy	No	714 (99.6)
	Yes	3 (0.4)
Antenatal care [†]	≤ First trimester	470 (65.6)
	> First trimester	247 (34.4)
Past adverse obstetric complication	No	649 (90.5)
	Yes	68 (9.5)
Present obstetric complication	No	630 (87.9)
	Yes	87 (12.1)
Intention of pregnancy	Planned / natural	526 (73.4)
	Accidental / unintended	191 (26.6)
Stress level		
Perceived stress scale	<i>M(SD)</i>	25 (7)

M(SD) = Median (Standard Derivation)

Total monthly family income[§]: MOP \$10,000 is considered as a cut-off because this monthly income is the median monthly domestic household income in Macao

Size of residence[‡]: 500 ft² is considered as a cut-off because this size is the median residence size in Macao

Antenatal care[†]: First antenatal care before or on 12 weeks' gestation is considered as the early booking

The majority of the women was over 25 years of age (69.9%) and married (90.5%). More than half (57.0%) of them had attained secondary-level or lower education. Women who had family medical history, personal medical past history and personal medical diseases were 42.4%, 19.9% and 10.0%, respectively. Few of them have allergy history (9.1%), smoking history (14.1%), alcoholic abuse history (9.8%), substance abuse history (1.0%) and taken chronic medication (1.8%). Most of them (80.1%) lived in nuclear family and good relationship with family members (80.2%). Most (77.3%) had full-time jobs, 97.4% of whom worked 10 hours per day or less. The majority (65.6%) received antenatal care in the corresponding hospital before 12 weeks' gestation. Around one quarter (26.6%) had an unplanned pregnancy. The mean score of the PSS was 25.

Table 2 Multiple linear regression model of demo-socio-economic, obstetric characteristics and perceived stress scale on physical health among Macau pregnant women (n = 717)

	B	Std. Error	β	Sig.
<i>Demo-socioeconomic characteristics</i>				
Educational level : $\leq$ Secondary	1.464	0.587	0.105	.013
Good to very relationship with family members	1.885	0.769	0.108	.014
Size of residence (size) > 500 ft ²	1.326	0.649	0.085	.041
<i>Obstetric characteristics</i>				
No obstetric complication	1.810	0.811	0.085	.026
<i>Stress level</i>				
Perceived stress scale	-0.101	0.042	-0.096	.017

VIF 1.060 - 2.287

Results form a multiple linear regression model after adjusting for demographic, socio-economic, obstetric variables

B = Unstandardized Coefficient

Std. Error = Standard Error

β = Beta, Standardized Coefficient

Sig. =Significance

VIF = Variance inflation factor

Table 2 shows the result of a multiple linear regression model of the significant variables and perceived stress score after controlling for demographic, socioeconomic and obstetric variables. The multiple linear regression revealed that pregnant women who were secondary or lower educational level ($\beta = 0.105$, $p = 0.013$), better relationship with family members ($\beta = 0.108$, $p = 0.014$), live in > 500 ft² residence ($\beta = 0.085$, $p = 0.014$) without obstetric complications ($\beta = 0.085$, $p = 0.026$) had significantly positively higher scores on the Physical Component of health-related quality of life (the women had better physical health) after adjustment as shown in Table 2. In addition, scores for the PSS ($\beta = -0.096$, $p = 0.17$) were significantly negatively associated with higher scores on the physical health after adjustment (Table 2).

Discussion

This is consistent with other previous studies (Mautner et al., 2009; Mota et al., 2008) showing that lower scores in physical functioning during pregnancy. One possible interpretation of this result is that pregnant women were likely reflective of the physical demands of pregnancy of body (Mota et al., 2008). Maybe women with physical complications (Gabbe et al., 2007; Kamysheva et al., 2009), this should be investigated in further studies.

Educational Attainment

Educational attainment has been reported in the literature to robustly associated with higher levels of physical health (Da Costa et al., 2010). Contrary to our expectations, results showed that pregnancy women who were lower educational attainment have a better physical health. The possible explanations might due to confounding of the association by unobserved factors such as cognitive ability and personality (Fujiwara and Kawachi, 2009). Indeed, education attainment might matter for health because it changes one's relative position or rank in society, and rank by itself might affect health (Cutler and Lleras-Muney, 2006). Why being lower educational attainment was significantly associated with better physical health is not clear and suggests the need for additional research.

Relationship with Family Members

We also confirm a previous study (Nohara and Miyagi, 2009) that pregnant woman who had satisfactory family relationship was more likely to have better physical health. Important aspects of family relationships include the extent to which family members are critical or blaming of each other, and the extent to which family members can express their feelings with each other and confide in each other (Holm, Bowler, Make, and Wamboldt, 2009). Indeed, family support has the greatest influence over women's health in order to enhanced quality of life (Schipper and Boheemen, 2009). In contrast, the unsupportive family relationships may lead to psychological distress, which in turn leads to impaired health-related quality of life (Holm et al., 2009).

Larger Size of Residence

The finding echo the results of the pervious studies (Jia et al., 2009; Kyle and Dunn, 2008), women who lived in a larger size of residence were likely to have better physical health. One possible interpretation of this result is that there is a casual relationship between larger size of residence and better functional health status (Jacobs, Wilson, Dixon, Smith, and Evens, 2009). On study showed that inadequate housing conditions appear to be an independent contributor to the risk of health problem (Schrootman et al., 2007). Residence is a stabilizing force in everyday life, which forms the foundation on which woman can establish a daily routine and begin to address other life issues (Kyle and Dunn, 2008). As a result, residence size is considered to be an important social determinant of physical health for pregnant woman.

Obstetric Complication and Physical Health

The present finding is in line with previous study (Mautner et al., 2009) that women without obstetric complications such as gestational diabetes and hypertensive disorder had comparatively better physical health compared to complicated group. Every year as many as 1.5 million women suffer obstetric complications during pregnancy that threaten the women's immediate survival (Fottrell et al., 2010). Women who survive severe obstetric complications are a vulnerable population who can suffer from physical problem during pregnancy (Lacasse et al., 2008). Therefore, the current study confirmed that obstetric complications lease to lower HROL especially in physical domain (Mautner et al., 2009)

Lower Perceived Stress Level and Physical Health

Our findings showed that women had lower perceived stress when they experienced better physical health. On the contrary, women who had higher perceived stress when they experienced impairment of their physical health-related quality of life. A possible explanation may be related to the limitations

in physical activities and role functioning of health of stressed women compared to non-stressed women, all of which may be linked to stress. It can impair the functioning of the immune, endocrine and autonomic systems (Segerstrom and Miller, 2004) and thus increase the likelihood of further impairment of stressed women's physical health (Young et al., 2004). Another possible explanation is that such women may be more likely to engage in or develop high-risk behavior (Ahluwalia, Mack, and Mokdad, 2004), such as smoking and substance use (Jesse, Graham, and Swanson, 2005) or insufficient physical exercise (Clarke and Gross, 2004). This behavior can contribute to health problems or immune system disorders that lead to physical health problems.

This study confirms the relationship between perceived stress and physical health. However, the direction of causality between the two variables is not clear. It could easily be argued that poor physical health predates higher perceived stress. Characteristics of poor health-related quality of life include poor functional status, fatigue, loss of energy, depression, anxiety, limitation in work or activities and performance difficulties (Ware et al., 2005), which could account for the lack of initiative of women so affected to share feelings with or seek pragmatic help from others. Thus, these women might lack psychosocial resources (Nierop, Wirtz, Bratsikas, Zimmermann, and Ehlert, 2008). Empirical evidence shows that women who experience poor physical health are more likely to report ongoing health problems and pregnancy complications that require further treatment, which increases their stress level (Moyer et al., 2008). Another possible explanation for our findings might be related to the relationship between poor health and women's perceived internal control of the birth outcome (Weisman et al., 2008). Those with poor physical health are more likely to perceive that they have little control over their birth outcome, which might elevate their stress level.

Limitations

This study has several possible limitations. First, although the study examines the demographic, socio-economic and obstetric variables of pregnant women who had better physical health, it may have overlooked a number of other variables, such as the physical activities and social networks or support groups. Further studies are therefore warranted. Second, the relationship between these variables cannot be tested adequately with the present cross-sectional research design, and can only be addressed through a longitudinal

study. Third, this study's convenience sampling and collection of data in a governmental setting limit the generalizability of the results. Despite these limitations, however, the study makes a number of contributions to the literature.

Implications of this Study

Our findings highlight the importance of examining the effect of demographic, socioeconomic and obstetric variables and perceived stress on physical health among Macao pregnant women. They are likely to be useful in the development of information packages for pregnant women, and can offer benefits to both women and their children.

Pregnancy may offer a unique window of opportunity in which to promote behavior and attitudes in women that can help them to reevaluate their physical health. The development of a checklist or structured questions for clinical situations is necessary to detect the high-risk group, with items measuring demographic, socioeconomic, obstetric variables, perceived stress and physical component in health-related of quality of life. Health care professional should design different interventions to improve quality of life and their interpersonal relationship during pregnancy (Rakhshani, Maharana, Raghuram, Nagendra, and Venkatram, 2010). In addition, encouragement of physical activity during pregnancy showed consistently positive association with better health-related quality of life (Klavestrand and Vingard, 2009). The enhancement of physical health, with improved vitality, less bodily pain, fewer role limitations caused by physical health and greater social functioning, to decrease stress levels (Roth and Robbins, 2004) during the antenatal period is desirable. Interventions would benefit not only women but also their families. The present study was undertaken as a preliminary investigation and thus the findings should be interpreted with caution. To acquire a more complete understanding of the mechanisms that determine maternal stress perception and physical health, further studies of the psychological and sociological health during pregnancy are required.

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Chapter V

Cooperative Learning in Physical Education

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Abstract

Cooperative learning is considered among the most effective teaching strategies in education. Yet, so far, there is limited evidence regarding its application in physical education. The present study was designed to investigate the impact of different cooperative teaching strategies on students' motivation and learning strategies. The participants were 272 high school students (age ranged from 13 to 15 years old) divided in four groups. Students in all groups were taught the same football task; in groups A and B using the teaching games for understanding approach (in group A students were divided in homogeneous groups in terms of ability and in group B in heterogeneous groups), and in groups C and D using the skill execution approach (in group C the reciprocal style was used and in group D the practice style). After the end of the teaching unit, all students completed the Situational Motivation Scale and the Motivated Strategies for Learning Questionnaire. The results of the analysis indicated that students in the reciprocal style group reported higher scores in help-seeking compared to

those in the practice style group. The findings of the present study provide useful information regarding the application of cooperative learning strategies in physical education.

Keywords: teaching games for understanding; skill execution; spectrum of teaching styles; situational motivation; learning strategies

Cooperative Learning in Physical Education

The use of cooperative activities, games, and practices is rather common in teaching school physical education (PE). Yet, as Dyson (2001) pointed out, there is only limited research on the effect of structured application of cooperative learning strategies on students' achievement, cognitive and affective responses in PE. Hence, the aim of the present study was to test for differences among three cooperative learning strategies and a non-cooperative one in the students' motivational regulations and use of learning strategies.

Cooperative learning reflects an instructional approach in which students work together in order to achieve a common learning goal (Gilles & Adrian, 2003). Fundamental facets of this approach are that the instruction is structured, students are grouped in small teams, and students with various levels of ability participate in the same team (heterogeneous in terms of ability) groups (Dyson, 2001). A basic objective of this approach is to help students master the task at hand, but also learn to be responsible for other's learning and be able to help other students learn too (Dyson, 2001; Gokhale, 1995).

Cooperative learning has been proliferated as a very effective instructional format in general education (Aronson, 2002; Hänze & Berger, 2007; Hijzen, Boekaerts & Vedder, 2007). It is thought that the active exchange of ideas within small groups increases interest, promotes critical thinking and lead to higher achievement (Gokhale, 1995). As Gillies (2004) pointed out, the use of structured forms of cooperative learning leads to better learning outcomes than traditional methods of direct instruction. However, although cooperative practices are applied in PE, there is only limited evidence on the use of structured cooperative learning strategies in the context of PE (see Dyson, 2001).

Teaching in PE has been based on the teaching styles described in the Spectrum of Teaching Styles developed by Mosston and Ashworth (1985,

2002). This spectrum is considered to be the most comprehensive and coherent framework of teaching styles (Byra, 2000; Kulinna & Cothran, 2003). The spectrum includes 11 teaching styles differing in the level of students' participation in decision making ranging from a core teacher-centered style (command style) to a core student-centered style (self-teaching style). The spectrum includes the following styles: (A) command, (B) practice, (C) reciprocal, (D) self check, (E) inclusion, (F) guided discovery, (G) convergent discovery, (H) divergent production, (I) learner's individual designed program, (J) learner initiated, and (K) self teaching. Styles A to E are considered effective in reproducing an existing knowledge or motor pattern (i.e., shooting in basketball), emphasize skill execution, and are very similar to direct instruction as the learning process is guided by the teacher who makes all the major decisions during the lesson. The styles from F to K are considered effective in producing new knowledge (i.e., different ways of throwing a ball). In these styles, students are actively involved in the learning process and their participation in decision making is gradually increased (Kulinna & Cothran, 2003; Mosston & Ashworth, 2002).

Kulinna and Cothran (2003) indicated that the reproductive styles were more frequently used by PE teachers. Among these the command, the practice, and the reciprocal styles were most commonly used. The command and practice styles are thought to represent direct instruction emphasizing skill execution as the teacher is responsible for the learning process, the focus is on reproducing a certain skill, and cooperative learning is not promoted. On the other hand, the reciprocal style, although placing emphasis on skill execution, requires students to work together in a way similar to the one cooperative learning describes. Students are grouped in small (usually heterogeneous in terms of ability) teams and provide feedback to each other helping their team mates learn and improve (Mosston & Ashworth, 2002). In this sense, the reciprocal style is an instructional format close to the concept of cooperative learning.

Recently another teaching approach emphasizing teamwork and cooperation between students has been recommended as effective in promoting skill development and creating positive experiences from PE lessons, the Teaching Games for Understanding (TGfU; Rink, 1996; Werner, Thorpe, & Bunker, 1996). Criticizing the typical approaches as highly structured and placing emphasis on the learning of motor skills rather than understanding the game, this approach emphasizes game appreciation and tactical awareness (Brooker, Kirk, Braiuka & Bransgrove, 2000). TGfU is considered a holistic pedagogical approach. In this approach game tactics,

decision-making, and problem solving are critical for learning the activity (Forrest, Webb & Pearson, 2006). The TGfU approach includes several games related to the actual activity giving the opportunity to students to learn while playing (Forrest et al., 2006). Students learn the activity at hand through concepts, tactics, and strategies rather than through skill execution (Wright, McNeill, Fry & Wang, 2005).

Preliminary research with this approach suggests that it is an effective way to teach motor activities in physical education as it enhances the cognitive and skill components of the activity and the affective responses of students. In fact, the combination of skill instruction and playing the game tactics was the most effective (French, Werner, Rink, Taylor & Hussey, 1996a; French, Werner, Taylor, Hussey & Jones, 1996b; Graham, Ellis, Williams, Kwak & Werner, 1996; Tjeerdsma, Rink & Graham, 1996). Subsequent research indicated that TGfU, although not always superior to the traditional skill execution approach in skill development (Harrison et al., 2004), it elicits more positive responses from participation in PE lessons, such as higher enjoyment and participation levels (Light, 2003; Light & Georgakis, 2005).

The present study was designed to extend previous research on teaching in physical education using the skill execution (see the Spectrum of Teaching Styles) and game playing (see the TGfU) by comparing different practices derived from these approaches. The dependent variables of the study were situational motivation and learning strategies. Taking into consideration that skill development has been extensively studied (see French et al., 1996a; Harrison et al., 2004) there is less evidence regarding the influence of such teaching practices on students' social-cognitive responses from the PE lessons. Situational motivation and learning strategies were selected, as they are both considered among the most important social-cognitive factors affecting students' experiences in PE. Briefly, motivation plays an important role in the formation of cognitive, affective and behavioral responses during participation in PE lessons (Deci & Ryan, 2002; Vallerand, 2007). Motivation mediates the effect of teacher initiated motivational climate and satisfaction of basic psychological needs and accordingly leads to positive or negative experiences (Vallerand, 2007). Self-determined forms of motivation, such as intrinsic motivation and identified regulation, evoke positive responses, such as higher effort and persistence, higher enjoyment, higher concentration, and less negative affect (Ntoumanis, 2005; Ntoumanis, Barkoukis & Thøgersen-Ntoumani, 2009; Vansteenkiste, Simons, Lens, Soenens, & Matos, 2005). On the other hand, less self-determined forms of motivation, such as external regulation and amotivation, have a negative effect on these responses. In

addition, motivation in PE can affect out-of-school participation in physical activities, with self-determined forms of motivation leading to higher rates of participation (Hagger & Chatzisarantis, 2009). However, although there is ample evidence on the determinants and consequences of contextual motivation, there is less evidence on situational motivation in PE (Vallerand, 2007).

Regarding the use of learning strategies in PE, there is evidence suggesting that the development of a cognitive plan can help the students comprehend the elements of the skill (Scantling, McAleese, Tietjen, & Strand, 1992). Early research in this area supported that creating a cognitive strategy about skill execution leads to better skill development (Bouffard & Dunn, 1993). Further, Ommundsen (2003) indicated that learning strategies could be affected by motivational variables in PE. Yet, there is no evidence, to the best of our knowledge, regarding how learning strategies are affected by different teaching practices.

Thus, the aim of the present study was to compare the effect of different cooperative learning on two important but understudied social-cognitive concepts in PE, situational motivation and learning strategies. Cooperative learning strategies were primarily developed in general education, and thus they proliferated the use of heterogeneous in terms of ability groups (Dyson, 2001). The rationale for this is that skilled students will help less skilled ones to master the task. However, this may not be the case in PE. For instance, it is very common that less skilled students impede the flow of an exercise (i.e., throw balls away, decrease the exercise's difficulty etc) that, in turn, diminish skilled students' interest and enjoyment of the task, and personal development. If this is the case, formation of homogeneous in terms of ability groups might be more effective as it would facilitate the flow of the exercises and the learning process (i.e., create different levels of difficulty for each group etc). In the present study, TGfU was primarily used as a format for cooperative learning. In order to test this assumption two conditions were created, one with homogeneous ability groups and one with heterogeneous ability groups. Based on the literature we hypothesized that students in both the TGfU conditions will report higher scores in intrinsic motivation, identified regulation, and learning strategies and lower scores in external regulation and amotivation compared to those in the skill execution conditions. Within each approach, we assumed that students in the homogeneous ability and students in the reciprocal style conditions would indicate higher scores in intrinsic motivation, identified regulation, and learning strategies and lower scores in external

regulation and amotivation compared to those in the heterogeneous ability and practice style conditions respectively.

Method

Participants

Junior high school students voluntarily participated in the study ($N = 272$, $M = 14.20$, $SD = .97$). The students were recruited from four schools in an urban city of Northern Greece. All students were Caucasians and attended typical co-educational Greek schools. The majority of the participants were native Greek nationals, while a small minority was immigrants from the countries of the former Soviet Union. These adolescents were second-generation immigrants having Greek language as their first language.

Measures

Motivational regulations. Students' motivational regulations were measured via Situational Motivation Scale (SIMS; Guay, Vallerand & Blanchard, 2000). The SIMS is consisted of 16 items assessing four dimensions of situational motivation (i.e., intrinsic motivation, identified regulation, external regulation, and amotivation). Participants responded to the stem 'Why did you participate in the PE lesson?' on a 7-point Likert scale, ranging from 1 (*does not correspond at all*) to 7 (*corresponds exactly*). Example item for intrinsic motivation is 'because the lesson was fun', for identified regulation 'by personal choice', for external regulation 'because I felt that I had to participate', and for amotivation 'I don't know; I don't see what PE lessons brings me'. Guay et al. (2000) provided evidence on the validity and reliability of the scale. Previous use of SIMS with Greek students supported its factor structure and internal consistency ($\alpha s > .70$; Katsani, 2010).

Learning strategies. The use of learning strategies by the students was measured with the Motivated Strategies for Learning Questionnaire (MSLQ) scale (Pintrich, Smith, Garcia, & McKeachie, 1993). The original questionnaire includes 15 scales representing different learning strategies. In the present study we employed three of them, which were more relevant to the task at hand: a) metacognitive self-regulation (9 items; example item 'if the

activities or exercises are difficult to understand, I change the way I approach them', c) regulation of effort (3 items; example item 'when the activities or exercises are difficult, I give up or take only the easy ones' and d) help seeking (4 items; example item 'when I can't understand something in PE, I ask the PE teacher for help'. The items were modified appropriately to reflect situations in PE lessons. Responses were anchored on a 5-point Likert scale, ranging from 1 (*don't agree at all*) to 5 (*agree completely*).

Research Design

Students were divided into four groups. Two of these groups were representing the TGfU (groups A and B) and the other two the skill execution approach (groups C and D). Students in all groups were taught the same football drill, dribbling. In group A ($N = 71$, boys = 35, girls = 31, 5 students did not report their gender, $M_{age} = 14.10$, $SD = .90$) students were divided into homogeneous groups in terms of ability and performed the drills provided by the PE teacher. In group B ($N = 66$, boys = 32, girls = 34, $M_{age} = 14.00$, $SD = .96$) students were divided into heterogeneous groups in terms of ability and then performed the drills provided by the PE teacher. In group C ($N = 72$, boys = 25, girls = 47, $M_{age} = 14.28$, $SD = 1.30$) students were divided in pairs and the lesson was organized with the use of reciprocal style. Finally, in group D ($N = 63$, boys = 30, girls = 33, $M_{age} = 14.42$, $SD = .49$) students were also divided in pairs but the lesson was organized using the practice style.

The lesson included a short warming up phase (7-10 minutes), four exercises to teach dribbling in football (5 minutes each), and playing the game at the end of the lesson (10 minutes). The first two exercises were common for all teams in order to introduce the dribbling skill to the students. The remaining two exercises were differentiated according to the students' group. In groups A and B these two exercises were developed based on TGfU recommendations (Forrest et al., 2006) requiring students to play several parts of the game. In groups C and D, the remaining two exercises were used as described in the national PE curriculum for secondary education (Papaioannou et al., 2005) for teaching dribbling with the reciprocal and practice styles respectively.

Procedure

Approval from school's principals was obtained to conduct the study in their schools. Students were informed that they have been chosen to participate in a large-scale study measuring their perceptions about physical education. Informed consents were administered to the students with the instruction to return them signed by their parents, if they did not want their child to participate in the study. No informed consent was returned signed. Students participated in the lesson provided by the PE teacher, according to the assigned condition, and immediately after the lesson, they completed the questionnaires. Both oral and written instructions were provided to students to enhance the comprehension of the items, and they were encouraged to ask clarifying questions. Students were also informed that their responses would be strictly confidential and will be used only for research purposes.

Results

Psychometric Properties of MLSQ

Exploratory factor analysis with varimax rotation was performed to test for the factorial validity of the MLSQ. The results of the analysis supported a 3-factor solution ($KMO = .821$, Bartlett test of sphericity = 807.79, $p < .001$) explaining 47.76% of the variance. All items fall into the original factors with acceptable loadings ($> .40$). Metacognitive strategies was represented by nine items (items 6, 9, 2, 10, 13, 3, 16, 14 and 8), effort by three items (items 1, 4 and 11) and help seeking by four items (items 5, 15, 12 and 7). Only one item (item 2; 'if the activities or exercises are difficult to understand, I try to do them without asking for help') showed multiple loadings and therefore excluded from further analyses. Internal consistency of the scales was tested via Cronbach's alpha. The results indicated high and satisfactory alpha for metacognitive strategies ($\alpha = .78$), low but acceptable for scales with less than ten items (Pallant, 2007) for help seeking ($\alpha = .62$), and low and not acceptable for effort ($\alpha < .40$). Therefore, the scale measuring effort was not used in further analyses.

Descriptive Statistics

Descriptive statistics of the study's variables for the overall sample and each group separately are presented in Table 1. The reciprocal style group indicated the higher mean score in intrinsic motivation, whereas the practice style group showed the lower one. In identified regulation, the homogeneous group reported the higher mean score, with students in the practice style group showing the lower score. In external regulation, students in homogeneous group reported the higher mean score and those in the reciprocal style group the lower one. The heterogeneous group indicated the higher score in amotivation and the reciprocal style group the lower score. Regarding both learning strategies, students in the reciprocal style group reported the higher mean score while those in the practice style the lower one.

Table 1. Descriptive Statistics of the Study's Variables

	Overall sample		Group A		Group B		Group C		Group D	
	M	SD	M	SD	M	SD	M	SD	M	SD
Intrinsic motivation	5.15	1.54	5.22	1.37	5.09	1.46	5.29	1.53	4.98	1.81
Identified regulation	4.89	1.38	4.99	1.18	4.89	1.34	4.88	1.45	4.77	1.58
External regulation	3.62	1.67	3.76	1.56	3.62	1.55	3.47	1.66	3.64	1.94
Amotivation	3.39	1.58	3.35	1.51	3.60	1.75	3.23	1.48	3.38	1.61
Metacognitive self-regulation	4.76	1.22	4.69	1.11	4.73	1.34	4.97	1.14	4.65	1.29
Help seeking	4.42	1.36	4.55	1.27	4.32	1.38	4.78	1.21	3.94	1.46

The results of the analysis of correlations among the study's variables in the overall sample are presented in Table 2. Intrinsic motivation was highly and positively associated with identified regulation, while negative and medium level correlations were found with external regulation and amotivation. Also, intrinsic motivation showed a high and positive relation to metacognitive self-regulation and a medium and positive relation to help seeking. Identified regulation indicated a low and negative association with external regulation and amotivation, and medium and positive relation with metacognitive self-regulation and help seeking. External regulation was positively associated with amotivation but negatively with metacognitive self-regulation. Amotivation showed a negative and low association with

metacognitive self-regulation. Finally, metacognitive self-regulation showed a positive association with help seeking.

Table 2. Analysis of Correlation among the Study’s Variables

	2	3	4	5	6
1. Intrinsic motivation	.75*	-.41*	-.38*	.63*	.36*
2. Identified regulation		-.21*	-.21*	.56*	.361
3. External regulation			.66*	-.19*	-.05
4. Amotivation				-.18*	-.06
5. Metacognitive self-regulation					.44*
6. Help seeking					

Note: * $p < .001$

Differences among the Groups

One-way analysis of variance (ANOVA) was performed to test for differences among the groups in the dimensions of situational motivation and the learning strategies. The results of the analyses on the dimensions of situational motivation revealed no significant differences among the groups. Regarding the learning strategies, the results of the ANOVA indicated significant differences among the groups in help seeking ($F_{3,270} = 4.77, p < .01$) but not in metacognitive self-regulation. The Scheffe’s post hoc test indicated that students in the reciprocal style group reported higher scores ($M = 4.78$) in help seeking compared to those in practice style group ($M = 3.94$).

Discussion

The present study was designed to test for differences among three cooperative and one non-cooperative teaching practice on situational motivation and learning strategies in PE lessons. The results of the analyses provided only partial support to our hypotheses. The TGfU conditions did not differ significantly from the skill execution conditions in situational motivation and learning strategies in PE lessons. Also, the two TGfU

conditions tested did not differ significantly to each other in any of the variables examined. On the other hand, the reciprocal style significantly differed from the practice style in help seeking.

The results of the study did not support the first hypothesis that TGfU conditions will foster self-determined forms of motivation and the use of learning strategies. This is contrary to prior research evidence suggesting that playful conditions in PE increase students' motivational, cognitive, and affective responses (Light, 2003; Light & Georgakis, 2005; Tjeerdsma et al., 1996). One possible explanation for these findings is the combined use of skill execution and playful drills in the lesson. Although prior research (French et al., 1996a; French et al., 1996b; Graham et al., 1996; Tjeerdsma et al., 1996) indicated that this combination is the most effective in terms of both skill development and having positive experiences, it seems that the way these approached were combined in the present study was not effective. Future research should further investigate the content of the teaching unit using this approach. Another possible reason for this non-significant result might be the short duration of the conditions' application. It seems that one teaching unit was not adequate to produce significant changes in situational motivation and use of learning strategies. This is further corroborated by the fact that only two exercises differ between the TGfU and skill execution conditions. Clearly future research should expand the timeframe of the application and well as the exercises used.

Interestingly, no differences were found between the two TGfU conditions. We assumed that creating homogeneous groups will increase the flow and the challenge of the exercises and, therefore, it will facilitate intrinsic interest (i.e., self-determined motivation) and the use of learning strategies. This hypothesis was not supported. A possible reason could be the short duration of the conditions' application. It is possible that during PE lessons students many times form homogeneous groups, as this might be their choice when they are allowed to decide for their teammates during playing. That is, they were familiar with this type of class organization. Therefore, a more consistent and long application of this type of group construction is needed in order to test for this hypothesis.

The results of the analyses partially supported the third hypothesis of the study. Students in the reciprocal style condition reported higher scores in help seeking compared to those in the practice style. No differences were reported in the dimensions of situational motivation and metacognitive self-regulation. The reciprocal style is very similar to the concept of cooperative learning (Dyson, 2001; Gokhale, 1995) as it requires cooperation in small groups where

one student provides feedback and helps the other. In this sense, it is easy to explain the higher scores in help seeking. Students in this condition received help from their teammates and learned to ask for help whenever they needed. On the other hand, no differences emerged regarding situational motivation and metacognitive self-regulation. Again, the short duration of the application is thought to be responsible for these findings. So far, there is only limited research on the effect of the different styles of the spectrum on skill development and cognitive, affective, and behavioral responses during PE lessons. Thus, future research should apply these styles for longer periods and test for their effect on students' responses. In addition, future research would benefit from the application of all styles of the spectrum and the investigation of the responses each one produces.

To summarize, the results of the present study indicated that students in the reciprocal style reported higher scores in help seeking compared to those in the practice style. No significant differences revealed for the other teaching practices on situational motivation dimensions and metacognitive self-regulation. The cooperative learning practices applied in the present study are thought to be interesting alternatives in current teaching of school PE. Yet, the short duration of their application did not allow them to show their potential in improving students' responses. In addition, future research would benefit by expanding on the responses studied. Cognitive responses such as attention, concentration, and intentions for out-of-school physical activity, affective responses such as enjoyment, satisfaction, anxiety, and positive-negative affect, and behavioral responses such as effort, persistence, and actual participation, are important factors determining the quality of a PE lesson. Understanding how these responses are affected by specific teaching practices will help practitioners apply the optimum combination of teaching styles in order to achieve the aims and objectives of school PE

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Chapter VI

Providing Nutrition Education to Community-Dwelling Older Persons

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Abstract

Aims To help community-dwelling older persons increase their knowledge and awareness of nutrition intake in daily living and engage

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with their health status through six consecutive weeks of a Nutrition and Lifestyle Program (NLP) in elderly community centers.

Background. In Hong Kong, older persons aged 65 or above comprised 13.0% of the total population in 2010; this is expected to increase to 28% of the total population by 2039 (Census and Statistics Department, 2010). Because of the growing number of older persons, the healthcare system may be better focused on prevention than treatment. According to a report from the Census and Statistics Department (2008), about 90% of older persons (85,571 out of 852,796) were living in domestic households, and the rest were living in institutions with residential care in 2006. The ageing population is increasing worldwide. Nutritional education is necessary for community-dwelling older persons since they are at high nutritional risk due to functional and cognitive decline in the aging process, diet-related chronic illness and poverty. According to the food policy in Hong Kong, nutritional labeling was commenced on 1st July 2010; older persons may require basic knowledge in food choices and adequate food to maintain optimal nutritional status.

Methods and Intervention. The Nutrition and Lifestyle Program (NLP) was conducted in association with the elderly center in the community. Twenty-five community-dwelling older people from the elderly centre were invited to join the 6-week NLP, which covered nutrition and common chronic illness among the elderly, the food pyramid of basic nutritional needs, identifying healthy and unhealthy snacks and food (e.g. those high in cholesterol, saturated fat, and salt), meal planning, nutritional labeling, and encouraging physical activity.

The NLP started with collecting demographic data (age, gender, health condition, educational level, financial situation and religion), in addition to information related to diet and exercise habit, basic nutritional assessment including calculation of Body Mass Index (BMI), measurement of mid-arm circumference, and collection of data in regard to food preferences.

Outcomes and Conclusion. As expected, results showed that older persons can enhance their nutritional knowledge. They can empower themselves with such knowledge in their daily living, thus reducing their nutritional risk and achieving better disease management through diet therapy. After the NLP, the older people had significantly increased their meat and fluid intake ($p < 0.05$). In addition, there was an increase in their consumption of fruits and vegetables, although the improvement was not significant. Besides the improved nutritional intake, physical exercise was significantly increased too ($p < 0.05$). It seems that at last it is possible for the elderly to retain their health and enjoy their life in the community rather than in the care of an institution.

Introduction

During the 20th century, the number of community-dwelling older people has increased dramatically due to improvements in health technology and healthcare delivery systems. Life expectancy in the Hong Kong population is the second longest in the world (Hong Kong Policy Research Institute Ltd., 2006), and the number of people aged 65 years and older has increased 11-fold since 1990, with an average life expectancy of 79.3 years for men and 85.5 years for women (Centre for Health Protection, 2008). In 2039, the aging population will reach 28% of the total population in Hong Kong (Centre for Health Protection, 2010). As longevity increases, so too does the impact of diseases and disabilities. Besides relying on medical therapy for maintaining their health, older people can also make simple changes in their lifestyle, including eating a healthy diet and doing physical exercise to reduce the deterioration of their health and continue a happy and fulfilling life in the community. According to the World Health Organization (2010), healthy diets and regular, adequate physical activity are major factors in the promotion and maintenance of good health throughout the entire life course. This is important for the concept of aging-in-place; older people prefer to live independently in their own homes rather than in an institution or care centre (Horner and Boldy, 2008).

Various articles have stated that diet has a strong influence on the risk and progression of the most common chronic, age-related diseases such as hypertension, cardiovascular disease, diabetes mellitus and cancer (Tse and Benzie, 2008; Kamp, Wellman and Russell, 2010).

The Centre for Food Safety in Hong Kong established the Food Labeling Law on 1st July, 2010, which directs producers to provide standard food products and more information to enable consumers to choose the healthier items they need (Centre for Food Safety, 2010). However, older people may have difficulty choosing healthier food products, hence the provisions for food labeling. The difficulties may be caused by different factors, including knowledge deficit, inadequate vision for reading food labels, financial problems, and functional limitations with food prepared by others (Sahyoun, 2002; Fey-Yensan, English, Belyea and Pacheco, 2003). According to Guthrie and Lin (2002), elderly with lower incomes consume significantly fewer calories than the high-income group, and fewer servings of major Food Guide Pyramid food groups and most other nutrients. It is therefore time to arrange nutrition education for the elderly population in the community to enable them

to maintain their health successfully and prevent or delay chronic disease morbidity (Sahyoun, 2002).

The aim of the study was to collect the nutrition status and dietary habit profiles of older persons living in the community in Hong Kong. It is expected that the interactive education of food nutrition and food labeling will enhance nutrition knowledge among older people, making a contribution to their personal health and therefore offering value to their whole family.

Methods

Design and Sample

This study used a quasi-experimental single group pre- and post-test design. After gaining approval from the Ethics Committee of the university, an elderly centre was approached and invited to participate in the study. The older people were recruited by convenience sampling in the elderly centre. Posters were put up and announcements made in the centre, inviting older people to join the study.

Written consent was collected from all participants. Inclusion criteria for the participants were being a member of an elderly centre and able to communicate in Cantonese. Exclusion criteria included having a history of mental disorders.

Intervention: Nutrition and Lifestyle Program (NLP)

In the study, a six-week Nutrition and Lifestyle Program (NLP) was conducted for older people by registered nurses. The NLP consisted of a one-and-a-half hour session per week for 6 weeks, and was carried out in the multi-function room of the elderly centre.

Each session of the NLP contained nutrition and exercise components. Basic nutritional information was provided at the beginning of the NLP, followed by nutritional information tailored to the requirements of those with common chronic illnesses such as hypertension, coronary heart disease, hyperlipidemia and cancer. Finally, discussions of food labeling and food purchases in daily life, including at supermarkets and in Chinese restaurants, helped the older people to be aware of the importance of nutritional knowledge in their daily life. There were two practical sessions: visiting the virtual

supermarket and healthy Chinese tea. The virtual supermarket visit tapped into the knowledge acquired in the previous class and required participants to choose snacks of their own by reading food labels and making a healthy choice. In the Chinese tea session, participants were treated to 'dim sum', which reinforced the acquired knowledge by encouraging them to eat an 'appropriate' amount of healthy 'dim sum', but to avoid over eating. Each session included nearly 30 minutes of physical exercise.

Nursing students attended the NLP, and each of them followed 1-2 older persons' nutrimental and health lifestyle progress. Each nursing student took care of their clients and solved their specific needs with a proactive and encouraging approach. Nursing students sometimes needed to make follow-up telephone calls and have meetings to ensure quality replies to participants' questions outside the classroom.

Data Analysis

Several statistical methods were used in data analysis. Descriptive statistical analysis of the quantitative data was conducted using the Statistical Package for the Social Sciences version 15. Demographic variables including gender, age, marital status, education level, religion and health history were measured among the older persons. Other valued nutritional information was also explored, such as grocery shopping, food buying and preparation, consumption of nutrients (bread and cereals, meat, milk, fruits and vegetables, and fluids), any denture problems such as feeding difficulty, and financial problems. In addition, Chi-squared tests were used to assess dietary and exercise habits among the older people, and then the nutritional knowledge among nursing students before and after the NLP. A p-value of <0.05 was considered statistically significant.

Results

Demographic Data

Twenty-five older people (22 females and 3 males) participated in the study. The ages ranged from 59-87, with the mean age 74.56 ± 7.752 (Mean $\pm$ SD). Table 1 shows the demographic data. Over 60% of the participants were suffering from chronic illness, including hypertension (36%),

diabetes (24%), hyperlipidemia (12%) and obesity (8%). As for their living condition, 60% were living alone and over a quarter lived with their spouse. The majority were widowed (40%). Nearly 70% of the older people had either primary education or no formal education at all. Over half of them had no religion.

Table 1. Demographic data

	NLP (N=25)
Age	
Mean±SD	74.56 ± 7.752
Range	59-87
Gender	Number (Percent)
Female	22 (88%)
Male	3 (12%)
Presence of Chronic Diseases	Number (Percent)
No chronic diseases	9 (36%)
One or more chronic diseases	16 (64%)
Health Conditions	Number (Percent)
Hypertension	9 (36%)
Diabetes	6 (24%)
Hyperlipidemia	3 (12%)
Obesity	2 (8%)
No disease	9 (36%)
Unknown	0
Other diseases such as respiratory diseases, cardiovascular diseases, gout, thyroid disease	6 (24%)
Religion	Number (Percent)
No religion	14 (56%)
Buddhist	4 (16%)
Christian	4 (16%)
Catholic	2 (8%)
Others: Japanese religion	1 (4%)
Living Situation	Number (Percent)
Living alone	15 (60%)
Living with wife/husband	7 (28%)
Living with children	3 (12%)
Living with wife/husband and children	0

	NLP (N=25)
Living with other people	0
Marital Status	Number (Percent)
Single	6 (24%)
Married	7 (28%)
Cohabiting	1 (4%)
Divorced/Separated	1 (4%)
Widowed	10 (40%)
Education Level	Number (Percent)
No formal education	8 (32%)
Primary education	9 (36%)
Junior secondary education	4 (16%)
Secondary education	4 (16%)
Advanced level education	0
Received Nutrition Education	Number (Percent)
No nutrition education received	12 (48%)
Had received nutrition education (group or individual consultation)	13 (52%)

Dietary and Lifestyle Pattern: Before and after the Nutrition and Lifestyle Program

Before attending the nutrition and lifestyle program, consumption of 'desirable' foods (fruits and vegetables) was low. Participants' intake of fruits and vegetables was inadequate, with 68% consuming ≤ 2 servings of fruit per day, which means that only 32% consumed an adequate amount of > 2 servings of fruit per day. Other than inadequate fiber intake, the participants had other poor eating habits in terms of the meat group intake as measured before the NLP; nearly 90% of them ate less than 4 taels of the meat group per day. This number was significantly reduced to 64% after the NLP ($p < 0.05$). In addition, there was inadequate fluid intake among the older people measured. In the study, nearly half the participants had fewer than 5 cups of fluid per day.

In terms of physical activity and exercise, it was good to find that 68% of the participants already exercised for 30 to 60 minutes daily, which is considered to be adequate.

Twenty-five older people completed the NLP. Upon completion of the NLP, 52% of the participants had better health perception than other elderly

people of the same age. The NLP was effective in terms of achieving desirable food consumption (meat, fluid, fruit and vegetables), increasing the frequency of doing physical exercise and enhancing quality of life, as they felt significantly better than others of their age group.

Table 2. Dietary and lifestyle pattern: pre- (n=25) and post-NLP (n=25)

	Pre-NLP (N=25)	Post-NLP (N=25)	
Knowledge of the BMI	Number (Percent)	Number (Percent)	p-value
Don't know what BMI is	19 (76%)	17 (68%)	0.55
Know what BMI is	6 (24%)	8 (32%)	
BMI	Number (Percent)	Number (Percent)	p-value
Underweight (<18.5)	2 (8%)	2 (8%)	0.79
Normal weight (18.5-22.9)	10 (40%)	8 (32%)	
Overweight (23-24.9)	4 (16%)	8 (32%)	
Severely overweight (25-30)	8 (32%)	5 (20%)	
Obese (>30)	1 (4%)	2 (8%)	
Grocery shopping	Number (Percent)	Number (Percent)	p-value
Done by themselves	23 (92%)	25 (100%)	0.32
Done by their wives/husbands	2 (8%)	0	
Done by their children	0 (0%)	0	
Done by a maid or someone else	0 (0%)	0	
Meal preparation	Number (Percent)	Number (Percent)	p-value
By themselves	19 (76%)	24 (96%)	0.24
By their wives/husbands	3 (12%)	0	
By their children	1 (4%)	0	
By a maid or someone else	2 (8%)	1 (4%)	
Habit of eating breakfast	Number (Percent)	Number (Percent)	p-value
Have breakfast every day	20 (80%)	24 (96%)	0.38
Do not have breakfast every day	5 (20%)	1 (4%)	

	Pre-NLP (N=25)	Post-NLP (N=25)	
Number of main meals per day	Number (Percent)	Number (Percent)	p-value
Two main meals per day	9 (36%)	5 (20%)	0.37
Three or more main meals per day	16 (64%)	20 (80%)	
Snacking habits	Number (Percent)	Number (Percent)	p-value
No snacks	10 (40%)	11 (44%)	0.55
Frequent snacks	9 (36%)	6 (24%)	
Occasional snacks or when hungry between main meals	6 (24%)	8 (32%)	
Consumption of bread & cereals per day	Number (Percent)	Number (Percent)	p-value
<1/2 serving	2 (8%)	1 (4%)	0.52
1.5-2 servings	16 (64%)	19 (76%)	
≥2.5 servings	7 (28%)	5 (20%)	
Consumption of meat group per day	Number (Percent)	Number (Percent)	p-value
<1 tael	8 (32%)	2 (8%)	0.003#
2-4 taels	14 (56%)	14 (56%)	
Frequency of opening bowel	Number (percent)	Number (percent)	P-value
Once a day	21 (84%)	22 (88%)	1.000
Once every 2 days	3 (12%)	2 (8%)	
Once every 3 to 5 days	1 (4%)	1 (4%)	
≥4 taels	3 (12%)	9 (36%)	
Consumption of milk group per day	Number (Percent)	Number (Percent)	p-value
<1/2 cup	16 (64%)	13 (52%)	0.06
1/2- 3/4 cup	5 (20%)	4 (16%)	
≥3/4 cup	4 (16%)	8 (32%)	
Consumption of fluids per day	Number (Percent)	Number (Percent)	p-value
<3 cups	3 (12%)	0	0.02#
3-5 cups	9 (36%)	3 (12%)	
≥5 cups	13 (52%)	22 (88%)	

Table 2 (Continued)

Consumption of fruit and vegetables per day	Number (Percent)	Number (Percent)	p-value
<1 servings	3 (12%)	1 (4%)	0.08
1-2 servings	14 (56%)	11 (44%)	
≥2 servings	8 (32%)	13(52%)	
Risk of under-nourishment	Number (Percent)	Number (Percent)	p-value
At risk of under-nourishment	3 (12%)	2 (8%)	0.45
Not at risk of under-nourishment	22 (88%)	23 (92%)	
Drinking alcohol	Number (Percent)	Number (Percent)	p-value
Every day	0 (0%)	0	0.71
Sometimes	5 (20%)	3 (12%)	
Never	18 (72%)	22 (88%)	
Quit two or more years ago	2 (8%)	0	
Smoking	Number (Percent)	Number (Percent)	p-value
Every day	0 (0%)	0	0.32
Sometimes	1 (4%)	0	
Never	22 (88%)	24 (96%)	
Quit two or more years ago	2 (8%)	1 (4%)	
Physical exercise	Number (Percent)	Number (Percent)	p-value
Do physical exercise every day	16 (64%)	24 (96%)	0.03#
Physical exercise sometimes	5 (20%)	1 (4%)	
Physical exercise never	4 (16%)	0	
Duration of daily physical exercise	Number (Percent)	Number (Percent)	p-value
<30 minutes	4 (16%)	2 (8%)	1.0
30-60 minutes	17 (68%)	18 (72%)	
>60 minutes	4 (16%)	5 (20%)	

Eating difficulty	Number (percent)	Number (percent)	P-value
Yes	6 (24%)	7 (28%)	0.754
No	19 (76%)	18 (72%)	
Limited eating categories due to disease	Number (percent)	Number (percent)	P-value
No	15 (60%)	15 (60%)	1.000
Yes	10 (40%)	10 (40%)	
Financial difficulty in buying food	Number (percent)	Number (percent)	P-value
Yes	5 (20%)	4 (16%)	1.000
No	20 (80%)	21 (84%)	
Mid-arm circumference	Number (percent)	Number (percent)	P-value
less than 17 cm	1 (4%)	1 (4%)	1.000
17 to 20 cm	1 (4%)	1 (4%)	
more than 20 cm	23 (92%)	23 (92%)	
Meeting with friends or relatives	Number (percent)	Number (percent)	P-value
Yes	20 (80%)	22 (88%)	0.625
No	5 (20%)	3 (12%)	
How often the client meets with friends or relatives	Number (percent)	Number (percent)	P-value
Every day	3 (12%)	5 (20%)	0.653
Every 2 days	2 (8%)	1 (4%)	
Once every 3 to 5 days	2 (8%)	3 (12%)	
Sometimes	14 (56%)	13 (52%)	
No	4 (16%)	3 (12%)	
Asks for help	Number (percent)	Number (percent)	P-value
Yes	18 (72%)	18 (72%)	1.000
No	7 (28%)	7 (28%)	
Who they will ask for help	Number (percent)	Number (percent)	P-value
Spouse	4 (16%)	4 (16%)	0.407
Children or grandchildren	6 (24%)	4 (16%)	
Friends	5 (20%)	3 (12%)	
Community center	5 (20%)	6 (24%)	

Table 2 (Continued)

Others	2 (8%)	3 (12%)	
2 people or groups	2 (8%)	4 (16%)	
3 people or groups	1 (4%)	1 (4%)	
Strong-tasting food	Number (percent)	Number (percent)	P-value
Like	2 (8%)	2 (8%)	0.197
Tolerate	13 (52%)	7 (28%)	
Dislike	10 (40%)	16 (64%)	
Chinese tea	Number (percent)	Number (percent)	P-value
Every day	8 (32%)	7 (28%)	0.973
Sometimes	11 (44%)	15 (60%)	
Never	6 (24%)	3 (12%)	
Vitamins or other health-promoting products	Number (percent)	Number (percent)	P-value
No	16 (64%)	16 (64%)	1.000
Yes	9 (36%)	9 (36%)	
Is exercise good for your health?	Number (percent)	Number (percent)	P-value
Yes	20 (80%)	25 (100%)	0.102
Little bit	4 (16%)	0	
No	1 (4%)	0	
Walking habits	Number (percent)	Number (percent)	P-value
Yes	22 (88%)	22 (88%)	1.000
No	3 (12%)	3 (12%)	
Frequency of walking	Number (percent)	Number (percent)	P-value
At least once a day	15 (60%)	13 (52%)	0.228
Twice a day	3 (12%)	3 (12%)	
Once every 2 days	2 (8%)	2 (8%)	
Once every 3 to 5 days	2 (8%)	5 (20%)	
Sometimes	3 (12%)	2 (8%)	

Type of exercise	Number (percent)	Number (percent)	P-value
Housework	3 (12%)	0	0.604
Swimming	2 (8%)	1 (4%)	
Doing Tai Chi	3 (12%)	3 (12%)	
Walking	5 (20%)	3 (12%)	
2 types	5 (20%)	12 (48%)	
3 types	4 (16%)	3 (12%)	
4 types	2 (8%)	0	
Others	1 (4%)	3 (12%)	
Appetite change in past 3 months	Number (percent)	Number (percent)	P-value
Decreased	2 (8%)	1 (4%)	0.705
Slightly decreased	3 (12%)	2 (8%)	
Unchanged or increased	20 (80%)	22 (88%)	
Weight decrease in past 6 months	Number (percent)	Number (percent)	P-value
Unknown	5 (20%)	3 (12%)	0.832
Weight decreased by 1 to 3 kg	2 (8%)	1 (4%)	
Weight unchanged	18 (72%)	19 (76%)	
Weight decreased by over 3kg	0	2 (8%)	
Activities of daily living	Number (percent)	Number (percent)	P-value
Walk with aid	3 (12%)	1 (4%)	0.317
Leave home alone	22 (88%)	24 (96%)	
Hospitalization due to acute illness in past 3 months	Number (percent)	Number (percent)	P-value
Yes	0	2 (8%)	0.500
No	25 (100%)	23 (92%)	
Mental status	Number (percent)	Number (percent)	P-value
Severe dementia or depression	2 (8%)	1 (4%)	0.276
No dementia or depression	23 (92%)	24 (96%)	

Table 2 (Continued)

Living at home	Number (percent)	Number (percent)	P-value
No	3 (12%)	3 (12%)	1.000
Yes	22 (88%)	22 (88%)	
Daily intake of 4 or more prescription drugs	Number (percent)	Number (percent)	P-value
Yes	8 (32%)	6 (24%)	1.000
No	17 (68%)	19 (76%)	
Pressure sores	Number (percent)	Number (percent)	P-value
Yes	2 (8%)	2 (8%)	1.000
No	23 (92%)	23 (92%)	
Eating by self or fed by others	Number (percent)	Number (percent)	P-value
Feeding by self	24 (96%)	24 (96%)	1.000
Feeding by others	1 (4%)	1 (4%)	
Difficulty eating	0	0	
Health perception when compared with elderly people of the same age	Number (percent)	Number (percent)	P-value
Worse	5 (20%)	1 (4%)	0.032
Unknown	3 (12%)	1 (4%)	
Same	10 (40%)	10 (40%)	
Better	7 (28%)	13 (52%)	

* Chi-squared test was used.
A *p* value of < 0.05 was considered statistically significant.

Implications for Research and Practice

Unhealthy diets and physical inactivity are two of the main risk factors for raised blood pressure, raised blood glucose, increase blood lipids, overweight or obesity, and for major chronic diseases such as cardiovascular disease,

cancer, and diabetes (WHO, 2010). In Australia, it has been strongly and widely recommended that adults eat at least 2 servings of fruit and 5 servings of vegetables every day, which can benefit in reducing obesity and general weight control, reducing the risk of heart attacks and cholesterol problems, and bringing improvements in regular bowel movements and overall well-being (Dixon, Mullins, Wakefield and Hill, 2004). Indeed, for the older persons who attended the nutrition and lifestyle program and increased their intake of fruits and vegetables, though not significantly, these clinical effects are important. Increased fruit and vegetable intake can more or less enhance bowel habits among the older people, thus there was a significant increase in the fluid intake among the older people after the NLP. In the study, over 40% of the older people consumed < 5 cups of fluid per day before the NLP; a dramatic change was noted after the NLP, with 88% of participants consuming ≥ 5 cups. The Food and Drug Administration (2010) allows claims that food rich in fiber, such as fruits and vegetables, can prevent certain cancers and particularly colon cancers. According to the World Health Organization (2010), 2.7 million deaths worldwide per annum are attributable to low fruit and vegetable intake. According to the Centre for Health Protection (2010), colorectal cancer is a malignant neoplasm affecting the lower gastrointestinal tract; it is the second most common cancer in Hong Kong. It accounted for 16.8% of all new cancer cases in 2007. Therefore, reducing the risk of colorectal cancer can be achieved simply through increased intake of dietary fiber (e.g. fiber from fruits and vegetables), decreased consumption of red and processed meat, and increased physical activity.

Malnutrition is a common nutritional problem among older people. For elderly people, food insecurity and reduced food intake may occur due to various factors including poverty and economic uncertainties, functional limitations in food preparation and buying, and also living and eating alone (Sahyoun, 2002). In our study, over one-fifth of the older participants had financial difficulty in buying food. Inadequate nutritional intake can affect functionality, independence, and quality of life, and the consequences are even more severe among the elderly population since growing older with nutritional risk may further complicate any existing medical situations. In the study, only 9% of older people consumed 4 taels of meat or more per day before the NLP, which may not meet the daily basic requirement. Meat provided the main source of protein intake, with the important function of growth and body repair (Centre for Food Safety, 2010). It is important to consume an adequate amount and variety of meat on a daily basis, especially for older people. Sometimes older people with chronic illness may limit their eating categories excessively,

which may worsen their general condition. In the study, over 40% of the participants had limited eating categories due to their illness. Nutrition knowledge was necessary to enable older people to optimize their nutritional intake and reduce the occurrence of malnutrition and overeating.

In addition, physical exercise and activity were significantly increased ($p < 0.05$) after the NLP. Various articles have mentioned multiple benefits of regular exercise among older people, including delaying functional decline and maintaining mobility, improving pain management, and improving range of motion for the prevention of falls (Rydwik, Kerstin and Akner, 2005; Chin A Paw *et al.*, 2008; Tse, Wan and Ho, 2010). In addition, physical exercise improved the older persons' health condition, as the majority suffered from chronic illness such as hypertension, diabetes, hyperlipidemia and obesity. Indeed, a similar improvement was found in psychological health among the older people: their perception of their own health was better when compared with others of the same age after the NLP ($p < 0.05$).

Finally, the NLP provided two practical sessions, visiting the virtual supermarket and healthy Chinese tea, which were designed to recreate typical social activities among these older people. Nearly 50% of them had never previously received nutrient education. After the food labeling policy started on 1st July, 2010, it became necessary to provide nutrient knowledge and practice for reading labels on pre-packed food products in daily life. In addition, 76% of the older people took Chinese tea either sometimes or every day as a usual activity. It was important to alert them to the importance of choosing healthier 'dim sum' and avoiding over eating. Nurses and healthcare providers play a significant role in providing resources that can increase older people's food-purchasing power through a nutritional education programme, and engage them in the community (Cason, Cox, Burney, Poole and Wenrich, 2002; Sahyoun, 2002).

Limitations

This study has several limitations. First, memory-recalled measures were used among the participants with regard to their nutritional and exercise habits. There was no assurance that the positive reactions of the participants reflected actual behavioral changes in their nutritional and lifestyle practice. Second, a small convenience sample of participants was used, which may not yield enough generalizability of the findings.

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Chapter VII

CWC: Design, Development and Implementation

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Abstract

Traditional nutrition education programs that target obesity often focus on educating participants on meal planning, appropriate food choices, and reasonable portion sizes. While these are three important factors related to the education of healthy eating and weight management, instruction to consumers on the application of this knowledge with the development of the skills necessary for preparing healthy, appealing foods needs reinforcement. Nutrition education programs that focus on culinary skill development have been shown to be effective methods for improving the nutrition behavior of program participants. This chapter walks you through the complete process from designing to developing and finally implementing an engaging and unique culinary nutrition education program. Cooking with a Chef (CWC) has been delivered to a wide range of audiences and is used as an illustration of a well-executed program that utilizes key components, such as the pairing of a professional chef and a nutrition educator for delivery of the program, hands-on cooking activities, and an interactive learning environment.

Introduction

Traditional nutrition education programs that target obesity often focus on educating participants on meal planning, appropriate food choices, and reasonable portion sizes (MyPyramid, Weight Watchers, etc). While these are three important factors related to the education of healthy eating and weight management, instructions to consumers on how to apply of this knowledge with the development of the skills necessary for preparing healthy, appealing foods is lacking.

The Department of Health and Human Services' efforts to reduce obesity in America, the Food and Drug Administration published a report providing short- and long-term recommendations that, if implemented, could help reduce the country's overweight and obesity rate and help consumers lead healthier lives through better nutrition. Their recommendations are contained in the "Keystone Forum on Away-From-Home Foods." One key recommendation was:

Promote enhanced "lifestyle education" programs. Use a combination of social marketing campaigns and consumer education programs to provide "healthy lifestyle" education to help individuals eat more healthfully in today's food environment. Existing campaigns and programs could be enhanced or, as necessary, new ones could be created.

In accordance to this concept, in May 2010, the White House also released "The White House Task Force on Childhood Obesity to the President." This report focuses and expands on what we can do together to:

1. Create a healthy start on life for our children, from pregnancy through early childhood.
2. Empower parents and caregivers to make healthy choices for their families.
3. Serve healthier food in schools.
4. Ensure access to healthy, affordable food.
5. Increase opportunities for physical activity.

Nutrition education programs are one way to assist in these pursuits of curbing obesity in both children and adults by providing the knowledge and tools necessary to sustain healthy eating behaviors of entire families. Furthermore, nutrition education programs that focus on culinary skill

development have been shown to be effective methods for improving the nutrition behavior of program participants (Birkett et al, 2004; Capps et al, 2002; Cavallero et al, 2004; Keller et al, 2004; Keller-Olaman et al, 2005; Masley et al, 2001; Newman et al, 2005). More time should be devoted to the discussion of the roles that sugar, fat, and sodium play in the production of flavorful, satisfying foods, and skill development of alternative methods of cooking for the creation of equally flavorful but healthier meal items should be emphasized (Albright et al, 1997; Condrasky, 2006; Michaud et al, 2007; Lang et al, 1999). If consumers are to sustain healthy eating behaviors acquired through nutrition education efforts, programs targeting healthy cooking education that emphasize the principles of culinary nutrition to teach participants the skills necessary to support healthy eating behaviors for a lifetime are needed. It appears that this can be accomplished effectively when dietitians and culinary experts work together as a team to execute community culinary nutrition experience (Condrasky and Hegler, 2009; Condrasky et al, 2008).

CU CHEFS® (Clemson University Cooking and Healthy Eating Food Specialists) is a registered trademark nutrition education program of Clemson University designed to promote changes in menu planning, food purchasing, food preparation and food consumption behaviors with a goal of fostering good health through healthy nutrition. CU CHEFS utilizes the concept of culinary nutrition to target culinary skill deficits and influence healthy eating behaviors. Culinary nutrition is the application of nutrition principles combined with food science knowledge displayed through a mastery of culinary skills (Condrasky and Hegler, 2010). The results are healthy eating behaviors grounded in culinary confidence and nutrition alertness. Therefore, CU CHEFS strives to promote awareness of the latest trends in foods and nutrition through the demonstration of proficient culinary skills to produce flavorful, health-inspired menus.

With some existing literature showing the positive effects of educating program participants on healthy meal preparation skills on food preparation and eating behaviors (ADA evidence-based library), the Cooking with a Chef (CWC) is a CU CHEFS instructional program that was developed with culinary nutrition principles aimed at educating consumers on methods for the preparation and intake of healthy, appealing meals. Utilizing experts from two independent disciplines, CWC combines the knowledge of a nutrition educator with the skills of a professional chef to deliver a hands-on culinary experience to program participants. This was determined to be an ideal model for a CU CHEFS program according to research findings (Condrasky, 2006). With

limited references on the use of culinary nutrition in consumer nutrition education programs, CU CHEFS – CWC has been an ongoing development over the course of a 7 year period and has been implemented in varying populations including college-aged students and faith-based participants to ensure program adaptability. Previous implementation of cooking-related programming has been effective with similar populations (Byrd-Bredbenner, 2004, Larson et al, 2007; Larson et al, 2009; Lasater, 1997; Thomas, 1994). The final CWC program is the result of three phases of development that include a thorough needs assessment with the formulation of a valid and reliable survey instrument for measuring program efficacy (Michaud, 2008). Formative process evaluation helped with program development and improvement and with resulting revision of curriculum and lesson plans to ensure long-term program quality and reproducibility. This chapter walks you through the complete process described as three phases—design, development, and implementation—of an engaging and unique culinary nutrition education program.

Phase 1: Needs Assessment (Precede)

The formulation of CWC was based on a PRECEDE-PROCEED integrative planning model (Green, 1991) (appendix or figure). The PRECEDE component of the model allows for a thorough needs assessment using five phases of analysis including social, epidemiological, behavioral/environmental, educational/organization, and administration/policy diagnoses of the proposed population and community. Once needs are identified, curriculum for meeting objectives addressing these needs are created. The implementation of the program takes place during the PROCEED component of the planning model along with formative evaluation and efficacy analysis of the program. The needs assessment component for CWC initially evaluated the needs of mothers with young children enrolled in South Carolina Head Start programs. Head Start is a national program that promotes school readiness by enhancing the social and cognitive development of children through the provisions of education, health, nutrition, social, and other services to enrolled children and families.

1. Social

Social diagnosis was made through direct observations at Head Start centers and meetings with center directors as well as informal discussions and interviews with parents and staff. Initial results from social diagnosis found that children enrolled in SC Head Start programs were frequently overweight, consumed below RDA of fruits and vegetables, and relied heavily on fast food restaurants for meal provision (<http://www.acf.hhs.gov/programs> - Head Start database). Mothers and caretakers of children enrolled in Head Start, Head Start center managers, staff specialists (nurses, social workers, and parent advocates), and Head Start teachers in the Upstate of South Carolina and DHEC nutritionists in Columbia, SC, were informally interviewed and provided insight into possible knowledge deficits and preferred methods for learning about nutrition in this community setting. Data collection tools were administered, revised and tested for validity and reliability in the remaining needs assessment process.

2. Epidemiological

Epidemiological diagnosis was based on demographic statistics from local and state Head Start demographic databases: (<http://www.acf.hhs.gov/programs>).

3. Behavioral and Environmental Diagnosis

The Meal Ideas Survey instrument was administered to assess for behavioral and environmental diagnosis. The tool was created to gather information regarding overall health, group anthropometrics, etc. Also, it was used to learn about what families cook at home, how they determine menus as well as where they gather information and ideas pertaining to their meal ideas. The tool was tested for validity and reliability and was found to be a valid and reliable instrument ($r = .80$ on test retest) (Condrasky and Griffin, 2007). Sample items may be made available in a sidebar.

This survey instrument was administered to a sample of 437 women between the ages of 20 and 50 years old with family meal preparation responsibilities during the one year period of 2003 to 2004. The women respondents included those from the general population attending the Every

Woman Upstate convention, high school teachers, employees of Lunch and Learn, DHEC professionals and nutritionists, students, and participants from CDC seminar and State Health meeting. The tool assessed behavioral and environmental diagnosis and demonstrated high consistency and reliability across all groups of race, education, gender, and weight category. The findings showed that 35% of respondents considered themselves of normal weight, 40% prepared dinner at home 5-7 times a week, and 52% said chefs have some influence. (Condrasky and Griffin, 2007). Pertinent items from the Meal Ideas Survey instrument were included in the final CWC survey tool (Michaud tool development) along with more targeted questions relating to cooking skills and evaluation of self-efficacy for additional data collection.

4. Educational/Organizational Needs

Evaluation of predisposing factors (knowledge, attitude, behavior, and self efficacy/perspective), reinforcing factors (reward of positive behavior or deter of negative behavior strategies), and enabling factors (actions by others that support or encourage menu choice behaviors and the presence or absence of conditions in the environment that facilitate positive actions) diagnosed educational and organizational needs.

A tool designed to measure this information was developed and tested in a collaborative effort between the University of South Carolina and Clemson University investigators (Evans et al, 2006). Specifically a measure of social support and parental motivation specific to their child's intake of fruits and vegetables was designed. The instruments were administered to parents and caregivers /women whose children were enrolled in the SC Head Start program or in elementary schools (n=203) and factor analyzed (Dave et al, in review).

The administered survey tools were modified from an existing instrument developed by Sallis and Williams (Sallis et al, 1985). The modified tools were found to be valid and reliable tools and included the Instrumental Social Support by Parents Scale (ISSP) [test-retest correlation coefficients for the scales $r=0.94$ ($p<0.05$)], Emotional Social Support by Parents Scale (ESSPS) [$r=0.76$ ($p<0.05$)], and the Fruit and Vegetable Availability and Accessibility Indices (FVAAI) . These tools were used in the educational and organizational diagnostic phase of the CWC needs assessment, however the length and time requirements needed to complete these detailed surveys limited their use as a final tool, where targeted items were pulled from these surveys and

combined with relevant items from the Meal Items Survey in the final CWC data collection tool.

5. Administration and Policy Diagnosis

Administration and policy diagnosis was conducted through the development of a logic model designed by the principle investigator and based off of the social cognitive theory described by Bandura (1989). The logic model included a detailed plan to overcome barriers (economic costs, time costs, opportunity costs, and sustainability schedule) while maximizing the use of resources. For example, some of the factors used included background (i.e. income, education, ethnicity, eating habits), inputs and resources (i.e. chefs, nutrition educators, support staff), program activities (knife skills, basic cooking techniques, meal planning), external factors (i.e. community agencies, support from family and friends), and goals and impacts (increase consumption of fruits and vegetables, increase confidence in kitchen, reduce sodium intake).

Phase 1: Results and Discussion (Findings from the Needs Assessment)

Results of the subjectively obtained data for needs assessment indicated that 94% of low income black women wanted more information and practice on healthy meal preparation and 73% requested information on ways to incorporate fruits and vegetables into their meals and recipes. Needs for developing healthy ways to prepare state food commodities provided through the SC Food Stamps Program were also identified (79% of respondents). The newly developed survey tool was tested for validity and reliability after administration to program participants as described in Phase II. The findings from these tools led to the development of an intervention strategy to address the needs of this population. The program Cooking with a Chef was created and piloted in these Head Start participants in 2003.

Phase 2: Objective and Program Description / Pilot Study 2003 (PROCEDE)

The PROCEED component of the planning model takes place simultaneously with formative evaluation and involves the pilot study considerations for the program. The PROCEDE phase began with a pilot study aimed at determining if a hands-on cooking program could improve the frequency, nutritional adequacy, and self-efficacy of meals planned and prepared in the homes of low SES adults with children enrolled in the SC Head Start program in the Upstate (Greenville, Anderson, and Oconee counties) including five cohorts drawn from 23 SC Head Start centers.

The primary investigator, a registered dietitian and certified culinary educator served as the program coordinator and nutrition educator for the implementation of the program. Chefs were recruited for participation through the Upstate SC chapter of the American Culinary Federation (ACF) during the ACF monthly meetings. Three chefs volunteered for participation in the program and collaborated with the nutrition educator on developing six consecutive lesson plans based on specific food and nutrition principles related from the assessment phase of the this nutrition education project and from validated menu directed nutrition materials available from reliable sources. Specifically the following materials were adapted for the Cooking with a Chef pilot research data from participants: the DASH diet (Sacks et al, 2001) and the Volumetrics Eating Plan (Rolls, Drewnowski, Ledikwe, 2005) with consideration for Southern regional food acceptance and commodity food availability, such as crates of fruits, vegetables, beans and rice. The DASH (Dietary Approaches to Stop Hypertension) diet has been proven to lower blood pressure in studies sponsored by the National Institutes of Health and is based on an eating plan that increases fruit, vegetable and fiber consumption while decreasing fat and sodium intake. The Volumetrics Eating Plan developed by Barbara Rolls, Professor of Nutritional Sciences at Pennsylvania State University focuses on reducing the energy density of foods using the latest research on controlling hunger while managing calories. Each team-led lesson in the CWC program incorporated a primary emphasis on the development of culinary skills and nutrition knowledge through observation, taste tests, and hands-on-application of culinary nutrition concepts. The recipe ingredients were sent home with participants and a questionnaire collected the following session on how the caregiver made the dish, changed the dish, and

perception of family to the dish. This information fashioned the CWC participant manual recipes and materials.

For the pilot, a demographic scan of the caregivers of the general population of upstate SC was performed and compared to the Head Start population which consisted of 1400 enrolled children. Invitational flyers were provided to all parents/caregivers at the sites in their county to come to a central center for CWC participation. The demographics Head Start population in the Greenville County Head Start program showed that 26% of children live in single parent homes and a total of 640 families are included in the Greenville County Head Start rosters. Of these, 5.3% were Hispanic/Latino, 18.6% were African American (AA) and 73.6% were Caucasian Participants who did not fall into these categories were classified as 'other' and composed 23% of the Head Start population. Five cohorts making up a convenience sample of parents and caregivers of children participating in SC Head Start program between 2002 and 2003 were recruited for the first Cooking with a Chef program (total n=41). Findings from this scan indicated that participants in the Head Start Program were similar to the general population, suggesting that results from this study could be applied to the greater population.

Subjects enrolled in the program were provided with specific program details and signed for informed consent upon enrollment for program participation. A reminder notice and follow up phone call was used for participant retention before each lesson. The lessons were conducted in two hour weekly sessions for six consecutive weeks in the classrooms of five Head Start Centers. Participants were provided with written program materials and then worked with the chef and nutrition educator to apply the lesson topics presented. At the conclusion of each lesson, fact sheets, food items, and instructions for the use of the culinary nutrition concepts acquired at each lesson were sent home with participants.

Funding for CWC was secured through university start-up research funds. Food items used during each lesson were donated by a local supermarket and included items provided through the state commodity food program. Incentive gifts related to culinary nutrition were provided to participants at the conclusion of each session. Data were collected using previously established instruments developed by the USDA for the Evaluation Reporting System 4 (ERS4) (<http://www.csrees.usda.gov>). These tools included The Adult Enrollment Form, The Homemaker's 24-hour Food Recall Form, and The Food Behavior Checklist originally developed for data collection of the efficacy of the EFNEP (Expanded Food and Nutrition Education Program). Questions formulated for these tools have been previously assessed for

criterion validity and test/retest reliability and have been identified as valid and reliable tools for use in this population. The Adult Enrollment Form collected demographic data and additional information about level of participation in Head Start, Food Stamp, and WIC (Women, Infants, and Children) programs. The Homemaker's 24-hour Food Recall was used to collect information about the quality and quantity of intake, specifically assessing number of servings consumed from the USDA (United States Department of Agriculture) food groups and the methods of preparation for these foods. The Food Behavior Checklist was used to collect data on frequency of meal planning and preparation, use of pricing, grocery lists and nutrition fact panels for healthy food purchasing, and food preparation techniques utilizing food safety recommendations.

Post intervention data collection included the above tools as well as subjective data collection instruments. Informal focus group discussions held at the end of each of the 6 sessions were administered in an attempt to gather subjective evaluation of the program for future lesson development. The Program Evaluation Form was administered at the conclusion of the entire 6 week program to elicit feedback from caregivers on their overall experience with the culinary nutrition education program.

Phase 2: Results and Discussion

Descriptive statistics using SPSS for the evaluation of demographic data were performed. Forty one subjects from 5 cohorts who qualified for the Emergency Food Assistance Program (TEFAP) and who were enrolled in the SC Head Start program participated. Demographics demonstrated 95% of participants were women (n=39) and 5% of participants were men (n=2). Sixty percent of participants were African American, 30% were Hispanic, and 10% were Caucasian and the mean age of participants was 25 years old. All participants qualified for The Emergency Food Assistance Program (TEFAP) as identified by Head Start participation (for enrollment criterion, see <http://www.acf.hhs.gov/programs/hsb2/biblio/development.jsp>).

Pre-Intervention Results

The Homemaker's 24 hour food recall form and Food Behavior Checklist (FBC) indicated that the number of servings from the fruit and vegetable

($x=1.2$), dairy ($x=.8$), and grain ($x=4.6$) food groups was below the USDA recommendations for healthy eating (Reference: USDA recommendations are 5 servings from fruits and vegetables, 3 servings from dairy, and 6 servings from grains). Results also indicated that participants met or exceeded recommended servings of foods from the meat group ($X=6.7$ oz).

Post-Intervention Results

While results from Homemaker's 24 hour food recall and the Food Behavior Checklist (FBC) found no statistically significant differences ($p<.10$) in the number of servings eaten from pre- to post-test intervention for any of the food groups identified, positive behavior changes were demonstrated. Non-statistically significant findings showed positive changes in frequency of shopping with a grocery list (30% of the participants who said they do not or are not likely to use list in pre survey indicated they would use list at the post survey administration, not thawing frozen food at room temperature (with 68% of naysayers indicating they would thaw with recommended techniques), using the nutrition facts panel to make food choices (45% of naysayers would now use the panel), and eating something within two hours of waking (36% of the naysayers at post survey planned to eat within two hours of waking). Interpretation of these findings would suggest that some improvements were demonstrated in food-related behaviors tested with the FBC from pre- to post-intervention.

Results from the Program Evaluation Form and focus group discussions showed a unanimous positive response from caregivers regarding the program model used in CWC with high levels of acceptability for the hands-on experiences and skills training provided by a chef and nutrition educator team. These findings provided the justification for further program development and evaluation and provided the rationale for use of this nutrition education model as a viable method for reaching and influencing low-income families to make positive changes in food-related behaviors. (Condrasky, 2006)

Discussion

While the results of the pilot study did not reach statistical significance, positive changes in food behavior were consistent with previous findings from a variety of cooking-based nutrition education programs (Birkett et al, 2004; Capps et al, 2002; Cavallero et al, 2004; Keller et al, 2004; Keller-Olaman et

al, 2005; Masley et al, 2001; Newman et al, 2005). CWC demonstrated further support for the use of culinary skills development as a component of effective nutrition education programming. These preliminary findings provided reasonable support for further, systematic evaluation and development of the program through process evaluation. The time and labor required for the team approach is intense thus further evaluation into the success of the program with a nutrition educator leading the group rather than having a chef present for the program delivery was deemed appropriate for trial.

Phase 3: Formative Process Evaluation (Procede)

Through a series of on-going grant supported phases from DHEC, systematic process evaluation was conducted to collect additional information about the quality and effectiveness of the program. Three projects ensued:

- 2006 Inman and Spartanburg CWC control with no hands-on cooking with chef vs intervention CWC with chef and RD team;
- 2007 two parent/caregiver groups at two Spartanburg church locations with CWC program; and
- 2008 ZL Madden center expansion of CWC intervention program administered with three groups (parents/caregivers, cooks, and teachers).

Process evaluation is a method of identifying strengths and weaknesses of a program's methods, allowing for improvements to be made based on participant, facilitator, and third party observation (Dr. Saunders was a consultant with our project reference). The model for the process evaluation in the CWC program was based on the evaluation plan described by Saunders, which provides a 6 step evaluation plan including: 1) fully describing the program, 2) describing the delivery of the program, 3) development of a list of potential process-evaluation questions, 4) determining the methods to be used for process evaluation, 5) consideration of program resources, characteristics, and context, and 6) finalization of the process evaluation plan. Saunders suggests a collaborative approach with a team of multidisciplinary participants involved in the evaluation planning and recommends that the process maintain a flexible format, allowing for method improvement along the way (Saunders,

Evans, and Johsi, 2005). “Breaking bread” questions were used during shared meal time were designed and implemented by the education team to gauge participants’ retention and application of cooking techniques as well as meal planning concepts.

Process evaluation utilized a variety of assessment tools. Data collection instruments and program materials were carefully analyzed and revised for the process evaluation initiation. Subsequent revisions were made as indicated by evaluation results over the following sessions of CWC programming. Data were collected during the implementation of the 2006, Spartanburg CWC control (no chef) versus intervention (with chef) program series using the survey tool that targeted specific objectives of the culinary nutrition CWC program and was tested to be a valid and reliable instrument (Michaud, 2008).

The specific objectives were to determine the changes occurring in knowledge and food behavior related to participation in the 2006 CWC control versus intervention program, and in meeting the targeted objectives for the subsequent program offerings in the 2007 and 2008 locations. Additional subjective data from program participants, facilitators, and third party observers were collected using post-session questionnaires containing open-ended, opinion-based questions and focus group discussions led by trained facilitators.

Phase 3: Results and Discussion

For the control versus intervention phase (2006), 34 participants completed the pre-test and 10 participants completed the post-test. Results of the pre and post test showed a statistically significant increase in the frequency of cooking behavior of participants in the intervention program with the chef and nutrition educator team from 3.38 to 3.50 ($p=.09$ at 0.1 significance level) on a 5-point scale. In addition, a statistically significant improvement in cooking self-efficacy was reported with participant scores in the intervention group improving from 3.58 on the pre-test to 4.13 ($p=.0383$) on the post-test. Availability and accessibility of fruits and vegetables and knowledge of nutrition and culinary concepts also increased from .78 to .90 and from 3.71 to 4.10 respectively when the chef was an active team member in the program, however, these results did not reach statistical significance ($p=.18$ and $p=1.0$ respectively).

Results from pre- to post- test for cooking attitude and presence of emotional support remained virtually unchanged with the mean scores pre- to

post-test of 3.90 to 3.89, and 2.61 to 2.63 respectively ($p=.53$ and $p=.92$), and scores for the presence of instrumental social support and motivation showed a slight decrease of 3.47 to 3.41 and 4.62 to 4.59 respectively ($p=.82$ and $p=.40$).

The CWC teaming of a chef with a nutrition educator appeared to be an ideal model for the CU CHEFS instructional programming after findings from a controlled, intervention study comparing the results of the CWC program facilitated by the nutrition educator and chef (intervention) versus the nutrition educator alone (control) showed that participants in the intervention group consumed more fruits and vegetables at the conclusion of the study than the control group (Condrasky, 2006). Further evaluation of the program as facilitated by a nutrition educator (RD) and chef team (intervention) (control) found that participants scored higher on scales for Cooking Techniques Self-Efficacy; Self-Efficacy for Fruits, Vegetables, and Seasonings; and Knowledge of Cooking Terms and Techniques.

For the 2007 and 2008 CWC program expansion participant groups conclusions based on the results from process evaluation indicate that all major objectives of the program were being met during the implementation of the program. Statistically significant increases in rates of cooking frequency, cooking confidence, and use of fruits and vegetables in meal preparation were achieved at the conclusion of the program, and rates of availability and accessibility of fruits and vegetables in the home improved from pre- to post-testing (.7794 to .9000) despite failing to reach statistical significance ($p<.05$). This increase in mean scores for behavior indices suggests that participants were purchasing fruits and vegetables and making them available for their families more often after participating in the CWC program ($p=.1786$). Full participant support of the program and its implementation was established through the opinion-based results of the post-session questionnaires and focus group surveys.

Conclusion

PRECED-PROCEDURE integrative planning model (Green, 1991) was utilized in identification of the nutrition education program, needs and curriculum development. The method of process evaluation provided evidence that CWC program is reaching families of diverse socioeconomic status and meeting core program goals. Process evaluation methods used in the CWC program development provide an example of how the collaborative effects of two independent institutions can influence positive eating and cooking

behaviors for the overall health of program participants. The cooperative work between the university investigators and the DHEC representatives allowed for a nonbiased, external review of program implementation with a common observational rating tool. The program allowed for quality improvements that may not have been identified from facilitators alone. Acceptance of an outside perspective and constructive criticism of the program by its developers and facilitators was essential of this type of program collaborative design. Overall, the process evaluation of the CWC program resulted in the adoption of a formal evaluation process, a revised participant and facilitator manual, and inclusion of the CWC survey tool for the measurement of increases in participant's fruit and vegetable consumption at home.

Formative evaluation presents data collected through focus groups and individual interviews with participants, chefs, nutrition educators, and site administrators on program implementation, participant impressions, and program objectives during four subsequent program trials. The focus of responses was in the areas: program logistics, program suggestions, perceived impact and impressions, chef involvement, and comments of CWC core learning objectives. Formative evaluations, often through process evaluations strategies, are used to finalize intervention design. We demonstrate how the findings from this formative study were used to develop a logic model and refine the CWC program. During this evaluation process, logic models are often developed to help define the scope of the intervention and what constitutes complete and full intervention delivery. A CWC logic model was developed retrospectively as a product of the formative evaluation process for use as an evaluation tool for the CWC program. It outlines background factors, inputs and resources available, program activities, external factors, and the goals and impact of CWC.

The evaluation process described in the study reported led to a number of changes and improvements in the CWC program. Some of the most important modifications were in the areas of logistical, site preparation and time allotment changes. It became evident that the planning and the preparation for the program required more time and support staff than originally predicted. Assistance was needed in the organization of the materials, ingredients, and resource boxes for the program. At the site we observed what specifics in the kitchen and the general meeting space were necessary for safety, comfort and efficiency of the participants and the staff. The site set-up required our arrival approximately one hour in advance and that amount of time to clean-up afterwards as well. Allowing for more flexible time during the sessions was the key to enabling the participants to ask their questions or the chef nutrition

education team following the sessions. Time spent in training the chef varies with the experience of that professional. Some chefs are more comfortable in the CWC setting, and the development of chef training materials continues to transpire. Time requirement for the individual sessions was more easily gauged after these offerings were performed and evaluated as described in this piece. The 2-hour time frame for each lesson was the preferred time frame by the participants and the staff. The chefs indicated that they needed more time in the beginning to determine the culinary skill and kitchen safety competence of the participants. Thus, we recommend a get to know the participant time in the early session of the program. The formative evaluation has improved our understanding of how key elements were being addressed in the program and how to best deliver the program lessons.

Findings indicate high level of potential for the program building self-efficacy and change within the home environment, thus increasing participant motivation to cook. Lessons learned contribute to refinement of the program. The unique component of this program is the inclusion of a chef. Chefs are often natural teachers who are passionate and knowledgeable about cooking techniques, ingredients, and using the pantry method of cooking. Chefs help motivate participants by providing individual attention, sharing industry tips and techniques, and encouraging them to spend more time cooking. Chefs who assist the nutrition educator in delivery the program must possess social skills for group interaction, technical ability in demonstrating meal preparation, and teaching skills. They must be enthusiastic about the mission of the CWC program and committed to healthy cooking and eating and possess an interest in improving quality of life through better nutrition.

Conclusions from data compiled from all cohorts and measurement tools suggest that the CWC program is reaching intended audiences and meeting core program goals. The results described from the pre- and post-test, end-of session questionnaire, and focus group survey show that participation in the program can result in increased occurrence and confidence in at-home meal preparation, increased purchase and consumption of fruits and vegetables, and increased use of alternative cooking methods to lower sodium intake. Therefore, we can conclude that CWC as designed, developed and implemented as part of the CU CHEFS® instructional programs can be instrumental in achieving state objectives for improving the consumption of fruits and vegetables and thereby reducing the incidence of obesity in children and families.

The need for culinary nutrition education is gaining acceptance in the field of culinary arts as well as within the dietetic profession. In order to teach

consumers how to prepare healthy foods that are appealing and flavorful, adequate and appropriate training supportive of future culinary nutrition teams are needed. Potential program implementation exists for schools, faith-based settings, and others.

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Chapter VIII

Maternal Nutritional Education Before and during Pregnancy

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Abstract

Maternal nutritional status before and during pregnancy constitutes one of the most important determinants for fetal growth. Inadequate body weight before conception and low maternal weight gain are associated with adverse perinatal outcomes. The fetal origins hypothesis proposes that inadequate maternal nutrition and a low infant birth weight can predispose the child to diseases such as, diabetes and cardiovascular disease later in life. Pregnancy can be an opportune time to improve nutrition, and presents an ideal time for health promotion activities. However, many women of childbearing age do not maintain good nutritional status before and during pregnancy. They do not have an opportunity to get adequate and appropriate nutrition education in antenatal care. Most of them expect advice on general dietary improvements, with the remainder seeking advice on helping to promote

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their quality and quantity of nutritional intake. All women of reproductive age should be encouraged to follow the Government recommendation and eat a well-balanced diet. Health care providers need to ensure pregnant women know the positive and negative effect of poor maternal nutrition status, including the need for additional folate, at each physical check-up. An individualized approach is likely to have better outcomes than a standard intervention that is given to all pregnant women. A critical goal to achieve is for women to make behavior changes for good nutritional status before, during, and after conception, which may lead to improved birth outcomes.

Commentary

Evidence indicates that women with a normal prepregnancy body mass index (BMI) and those who meet the recommended weight gains are healthiest and have healthier children. Maternal nutrition may be a key factor influencing the health of women during pregnancy and the development of the fetus. Therefore, health care providers expect that pregnancy can be an opportune time to improve nutrition, and presents an ideal time for health promotion activities. In addition, they expect that not only pregnant women to be concerned about their nutrition for giving birth to healthy newborns, but also that young women who expect to be mothers in the future will try to eat a well balanced diet. Promoting good health and nutrition before conception may be at least as important as during pregnancy. However, the condition of women must be changed including body composition, eating habits, and management of weight gain.

Changes in Body Composition for Women of Reproductive Age

Maternal size before conception plays a key role in determining the perinatal outcomes. High prepregnancy BMI, overweight and obesity, is a risk factor for adverse pregnancy outcomes, such as gestational diabetes, preeclampsia, cesarean delivery, and having a macrosomic [Kabiru and Raynor, 2004]. An increase of prepregnancy BMI was reported in the USA, and about one-third of all pregnant women are obese. Fifty % of African American women, 40% of Hispanic women, and 30% of white women are obese. In addition, one-third of adolescents are classified as either overweight or obese [Ogden et al., 2008].

Overall, the prevalence of prepregnancy overweight has increased steadily among low income black, Hispanic, and white women in the United States. Similar trends have been observed in Europe, e.g., in Sweden and Switzerland [Berg et al., 2005]. Between 1992 and 2002, the incidence of overweight in women of childbearing age increased from 6.8% to 19.3% for women aged 14-24 years, from 11.8% to 19.3% for those aged 25-34, and from 18.0% to 24.8% for those aged 35-44. In the UK, 33% of women are overweight and 23% obese [RCOG, 2006]. The burden of nutritional problems may be shifting from energy imbalance deficiency to excess among adolescents in these developed countries. Weight gain has been attributed more to decreasing levels of physical activity than to increased energy intake. Thus, perhaps lowered energy expenditure is the major factor in the higher levels of obesity.

On the other hand, industrialized countries face not only the epidemic of obesity, but also face underweight in women of reproductive age. Low prepregnancy BMI has been associated with a higher incidence of miscarriage [Helgstrand and Anderson, 2005], the delivery of smaller infants [Sekiya et al., 2007], and intrauterine growth restriction [Ehrenberg et al., 2003]. The highest prevalence of underweight was observed in younger women and Asian women. The prevalence of underweight women has increased 19.6% to 21.2% in the age of 20-29 years, and 8.6% to 13.3% in the ages of 30-39 during the last two decades in Japan. A low body mass index in highly industrialized countries cannot be considered to be a result of environmental factors such as periodic food shortages and malnutrition, but as an expression of constitutional low weight or a result of cosmetically-induced starvation. Bringing maternal weight into a health range before pregnancy makes conception easier, improving pregnancy outcomes.

Current Maternal Nutritional Status

Maternal nutritional status before and during pregnancy constitutes one of the most important determinants for fetal growth. Lower intake of calories, grams of food, protein, and carbohydrates are associated with inadequate pregnancy weight gain [NRCIM, 2007]. On the other hand, high intake of calories leading to excessive weight gain has been associated with long-term obesity risks, and postpartum retention [Polley et al., 2002]. A good diet should provide the amount and variety of nutrients to ensure optimal health for both mother and baby. Each country issues recommended dietary allowance (RDA) as the mean of estimated requirements for pregnant women, which

needs to be increased to meet the demands of increasing maternal tissues, growth of the fetus, growing fat stores and the increase in basal metabolic rate (Table 1). .

Table1. Nutrient demands of pregnant women according to WHO, UE, USA and Japan

	additional energy. kcal/d	proteins g/d	Calcium mg/d	Iron mg/d	folic acid µg/d
WHO		51	1,000-1,200	12.5	370-470
Europe	200‡	48-60	700	17-21	400
USA	340†, 452‡	71	1,000	27-30	600
Canada	300†‡		1,000	27	600
India		65	1,000	38	400
Japan	350†, 500‡	60	600-700	19.5	440

† : in the second trimesters

‡: in the third trimester

Nutrient intake data from studies of pregnant women are summarized in Table 2. The mean energy intake was greater than the RDA in some studies, but not other micronutrient intakes. This over-nutrition and imbalanced diet can contribute, potentially to excessive gestational weight gain. On the other hand, consistent with the report of the American Dietetic Association that many women of childbearing age do not maintain good nutritional status during pregnancy [Kaiser et al., 2008], mean energy intake tended to be lower than the RDA in some studies, especially among women with low income, having a low birth weight, living in a rural area, or being at a younger age. Furthermore, the mean intake of calcium and iron was observed less than the RDA or close to the RDA.

Table 2. Reported average nutrient intakes during pregnancy in industrialized and developing countries

Country and Reference	Number of subjects	Energy kcal/d	Proteins g/d	Calcium mg/d	Iron mg/d	folic acid µg/d	Dietary assessment
USA							
Fowles ER et al. 2009	n=13, 19-31 years old	2653		961	20	387	24h dietary recall
	First trimester						
USA							
Rifas-Shiman SL et al. 2006	n=1543, 16-45 years old	2137±640		1168±344	16.7±5.9	367±134	semi-quantitative FFQ
	Second trimester						
USA							
Siega-Riz AM et al. 2002	n=1131 Non-Hispanic white women	2530±1192	94±42.1		18.2±8.8	604±284	FFQ
	n=971 Non-Hispanic black women	3220±172	115±64.1		22.3±12.5	736±432	
	Second trimester						
Canada							

Table 2. (Continued)

Country and Reference	Number of subjects	Energy kcal/d	Proteins g/d	Calcium mg/d	Iron mg/d	folic acid µg/d	Dietary assessment
Pick ME et al. 2005	n=52, 21-41 years old	2309±53.4		1,139±46.6	15.9±0.6	331±12.2	4-day food records
	Second or third trimester						
UK							
Rees GA et al. 2005	165 women with LBW infants						food records
	n=63 Caucasian	1832	68	780	10.7	227	
	n=36 African	1586	62.1	565	9.6	196	
	n=26 Asian	1750	67.5	629	11.7	217	
	n=40 African-Caribbean	1740	65.4	658	9.8	189	
UK							
Ford et al. 2008	n=83, low income women	1864.2±501.9 ^a	59±17	720±276		217±76	FFQ
	22±5 years old						
UK							
Mouratidou et al. 2006	n=250, 14-18 weeks	1880	74.2	692	10.2	204	FFQ
	15-43 years old						
Germany							

Country and Reference	Number of subjects	Energy kcal/d	Proteins g/d	Calcium mg/d	Iron mg/d	folic acid µg/d	Dietary assessment
Franke et al. 2008	Mean age 30.8 years old						FFQ
	n=68 Germany	2203				254	
	n=147 Spain	2934				304	
	n= 55 Hungary	2926				396	
	Third trimester						
Greek							
Petrakos et al. 2006	n=98, second trimester			1216±555.9	11.6±5.0	341.5±119.1	semi-quantative questionnaire
	n=102, third trimester			1282.5±546.3	11.9±4.9	351.1±155.0	
Kenya							
Kamau-Mbuthia et al. 2007	n=716	2055±537	59.3±22.4	441±386	16.1±5.4		24-hour food recall
India							
Agrahar-Murugkar et al. 2004	19-40 years old						
	n=52 low-income pregnant	2418.7±121.9	60.2±4.7	434.9±111.0	17.4±2.6		FFQ

Table 2. (Continued)

Country and Reference	Number of subjects	Energy kcal/d	Proteins g/d	Calcium mg/d	Iron mg/d	folic acid µg/d	Dietary assessment
	n=26 high-income pregnant	2633.8±328.1	77.0±14.9	456.1±145.7	23.2±7.5		
	Second or third trimester						
India							
Gautam VP et al. 2008	n=114, living in rural villages	1541±410.1	47.1±13.9		15.0±6.4	152.2±72.4	FFQ
	12 to 20th weeks						
Japan							
Takimoto et al, 2003	n=330, 20-49 years old	1869±498	73.7±22.8	597.7±296.8	11.0±4.6		food weighing
Japan							
Watanabe et al. 2008	n=197, 19-42 years old Second trimester	1754.8±442.3	57.1±21.5	521.5±213.4	6.1±1.9	261.6±94.3	FFQ

Values are presented as mean±SD

FFQ: food frequency questionnaire

a:7,8MJ.

One of the important micronutrients is folate, which can reduce the risk of neural tube defects (NTD), low birth weight of infants, and recurrent spontaneous abortion. A significant low mean folic acid intake was observed among younger women, multiparous, and poorly educated women from low income families [Gautam et al., 2008]. However, mean dietary folate intake is barely half of the recommended values and at an extremely low level in almost all studies during the 2000's.

A variety of methods have been developed for use in the assessment of nutrient status. As seen in Table 2, nutritional status was evaluated by a food frequency questionnaire (FFQ) on food recall or food weighing in the studies. Weighed food records, which are considered to be the gold standard of dietary assessment methodologies and provide a more precise estimation of an individual's actual nutrient intake, are associated with a large respondent burden, low response rate, and possible impact on usual food consumption. The FFQ gives useful estimates of nutrient intakes in pregnant women and the FFQ is a valid tool compared with 24 recalls. Nevertheless, over-reporting of nutritional habits and an underestimation of undesirable habits cannot be completely ruled out. The reliability of the self-reported data depends on whether participants are able to accurately recall past behaviors. In addition, the data in Table 2 is not broadly representative of most women of reproductive age in each country due to the limited sample number, and the lack of information about physical activity. Therefore, we should carefully evaluate the observed nutritional intake values.

Assessment of nutritional status is only evaluated by gestational and weekly weight gain, and nutritional intake. However, we should be more concerned about biochemical assessments for poor control of weight gain or poor nutritional status, such as plasma ketone levels, which are elevated with poor nutrition or poor diabetic control. Hyperketonemia can progress to the accelerated starvation of pregnancy should caloric intake be deficient [Knopp, 1997]. Plasma ketone levels may be useful as indicators of inappropriate weight control for diabetic women, but also for all pregnant women for weight control.

Optimal Weight Gain Management

Adequate weight gain is important for optimal perinatal outcomes. Some countries have devised pregnancy weight gain guidelines by prepregnancy BMI. Weight gain within the guidelines has been associated with healthy fetal

and maternal outcomes. Weight gain below the goals is associated with low neonatal birth weight, and weight gain above the goals is associated with neonatal macrosomia [Parker and Abrams, 1992]. Not only is excessive weight gain responsible for complications during pregnancy, it also contributes to increased postpartum weight retention.

The 1990 Institute of Medicine (IOM) recommendations, shown in Table 3, have been the standard for weight gain during pregnancy since 1990 [ICM, 1990]. Shieve et al. [1998] reported that two thirds of women gain more weight in pregnancy than is recommended by the IOM. Stotland et al. [2006] examined in 20,463 women with term singleton births, and reported that 43% of women gained weight above the recommended IOM range, whereas 37% gained within the IOM range, and 20% had weight gains below the target range. In a study of over 4000 women from the University of California, San Francisco Perinatal Database, 23% of underweight women, 49% of normal-weight women, and 70% of overweight women exceeded the recommendations [Carmichael et al., 1997]. These results suggest that the intervention including nutritional education, behavioral strategies to promote healthy and appropriate weight gain during pregnancy, was not effective for the targeted groups.

The recommendation may be not applicable to all women of reproductive age. Maternal anthropometry differs across race and age. The number of adolescent, Asian, Hispanics, and black women is increased. The recommendation must be set up for understanding their characteristics and a different classification of prepregnancy BMI needs to be applied. The current recommendations need to be updated, specifically for obese women and adolescents, because the 1990 recommendations did not consider the effect of weight gain on maternal outcomes of pregnancy. A produce ethnic-specific maternal weight gain recommendations is needed.

On the other hand, a lower amount of weight gain influences birth size. Decreased maternal weight gain is reported, decreased by approximately 2 kg from 1988 to 2002 in Japanese women, which lead to decreased average birth weight [Ueda et al., 2005]. Women who did not achieve the lower quartile value had more than twice the risk of having low-birth-weight infants. One of the possible reasons may be the restriction of weight gain excessively by health providers or the women themselves.

Table 3. Recommended gestational weight gains based on prepregnancy BMI

Pregnancy BMI	BMI category	Recommended total weight gain	
		(kg)	(lb)
Less 19.8	Under weight	12.5-18	28-40
19.8 to 26.0	Normal	11.5-16	25-35
26.1 to 29.0	Overweight	7-11.5	15-25
Over 29.0	Obese	at least 7.0	15
BMI: body mass index			

Women may try to lose weight or restrict weight gain by dieting behaviors including restricted food intake, poor quality diet and consuming a low daily energy diet, even after they become pregnant.

Additional weight gain and changes in body composition can leave many women feeling insecure about their body size and shape.

Eating attitudes and dieting practices of women due to preconceptions influence weight gain during pregnancy. It appears that women who diet habitually prior to becoming pregnant gain more weight during pregnancy and regard themselves as less accountable for their weight while pregnant [Clark and Ogden, 1999]. In a study undertaken in North Carolina, Mumford et al.[2008] found that an association between restrained eating and weight gain during pregnancy. Women with more than 19.8 kg/m², and a history of dieting or restrained eating gained more weight during pregnancy. In contrast, underweight women with a history of restrained eating behaviors gained less weight compared to underweight women without those behaviors.

Effective Nutritional Education

Promoting preconceptions for the health of women is a key public health strategy. Each country has special programs for improving women's health, especially for preventing NTD in offspring. The Public Health Service, including that of the U.S and Japan, recommends that all women capable of becoming pregnant consume 400µg of folic acid daily throughout childbearing years. Despite the abundance of information concerning folic acid, many women of reproductive age still are either not aware of its importance or do not value this information. The RDA guidelines have not worked effectively to appeal to the public.

Thiele et al. [2004] observed in Germany that better educated women had higher indexes of qualitatively beneficial diets than less educated women. Adolescents at universities and colleges are potentially important targets for the promotion of healthy lifestyle including physical, psychological and eating habits. However, little is known concerning nutritional and health related behavior. More effective education campaigns should be set up by health care providers to improve women's awareness. Dieticians should educate young women about careful selection of food and meal planning and preparation at the campus or through mass media.

The questions arises how pregnant women are concerned about their consumed diet, and whether pregnant women get appropriate nutrient information during their routine antenatal checkups. Bowman et al.[1998] reported that 79% of pregnant women consumed diets needing improvement. Nearly 80% of pregnant women need dietary advice [Orr and Simmons, 1979]. On the other hand, Anya et al. [2008] reported that women spend 3 minutes or less with their antenatal care providers and less than 40% had been informed or educated about diet and nutrition. These results suggest that pregnant women do not have an opportunity to get adequate and appropriate nutrition education in antenatal care. Most of them expect advice on general dietary improvements, with the remainder seeking advice on helping to promote their quality and quantity of nutritional intake. Health care providers should give individual graphs of their weight gains at each antenatal check up, having viewed as valuable sources of information on diet, nutrition, and exercise. An individualized approach is likely to have better outcomes than a standard intervention that is given to all pregnant women. A critical goal to achieve is for women to make behavior changes for good nutritional status before, during, and after conception, which may lead to improved birth outcomes.

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Chapter IX

Nutrition Education in the Workplace: Impact on Diet and Health

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Abstract

Nutrition education programs have been implemented in the workplace in an effort to improve the diet and lifestyle of employees and, therefore, reduce the incidence of many chronic diseases linked to overweight and obesity including, diabetes, cardiovascular disease and cancer. Despite the importance of this outcome, the success of these programs has varied. This chapter uses a qualitative, narrative approach to review research conducted over the past 10 years on nutrition programs in the workplace and attempts to identify those aspects associated with successful behaviour change among employees. This approach enables us to include a variety of methods of intervention and data collection and thereby allows identification of promising intervention approaches that might not be identified in review approaches that are based on quantitative meta-analyses.

The chapter reviews the evidence for both the efficacy and the effectiveness of nutrition education programs in the workplace (i.e., whether an intervention works under ideal, well controlled conditions,

versus whether the intervention works in the “uncontrolled” real-world work place) (Spraycar, 1995). In addition, the characteristics of efficacious and effective programs are described including the duration of the nutrition education programs, the type of programs offered to employees, and the settings in which the programs were implemented. The results of the review suggest the workplace is a viable context for delivery of programs designed to change food intake behaviours, and overweight and obesity prevalence, although the challenge is to achieve sustained change on these outcomes after the intervention concludes. The results of this review should be taken into account when planning future work-based education programs on nutrition.

Introduction

Overweight and obesity are associated with an increased risk of many chronic diseases including cancer, cardiovascular disease, and diabetes (Kumanyika et al., 2008; McMillan, Sattar, and McArdle, 2006; Must et al., 1999). Consequently, obesity is associated with significant health and financial costs for individuals and the community. Behavioural treatments, including nutrition education designed to facilitate dietary change, have been shown to result in weight loss and prevention of weight gain.

The context in which these programs are delivered has varied with a range of different nutrition interventions rolled-out in schools, church groups, community settings and workplaces. In the workplace context, the motivation to tackle rates of overweight and obesity and associated chronic illness, include; decreasing rates of absenteeism and sick leave, improving occupational health and safety outcomes, enhancing job satisfaction and organisational commitment, and decreasing staff turnover. In Britain, the National Audit Office (2004) estimated that obesity accounted for 18 million days of sickness absence and 18,000 premature deaths in 1998. Wanjek (2005) has argued that, in Canada, every \$1.00 spent on workplace health promotion programs achieves cost savings through reduced sick days and increased productivity of between US\$1.50 and US\$5.75. Another study that has explored the potential financial savings of eight nutrition interventions reported that all were cost-effective because of the health benefits that flowed from the dietary changes achieved and the subsequent reduction in health expenditure (Dalziel and Segal, 2007).

The nature of the nutrition education programs that have been conducted and evaluated during the last decade has varied widely on dimensions that

include sample size, type of intervention, duration of the intervention, the specific outcomes measured and the extent to which long term follow-up of treatment effects was conducted. As a consequence of the heterogeneity of these studies, the efficacy and effectiveness of nutrition interventions for overweight and obesity prevention or remediation remains unclear. The current chapter aims to review the research studies that have evaluated nutrition education programs in the workplace over the past 10 years.

The current review is limited to published studies and is therefore susceptible to the “file drawer problem” (Rosenthal, 1995). This refers to the tendency for studies with statistically significant results to be more likely to be published than studies with nonsignificant findings. Therefore, studies with nonsignificant results may be unreported and consequently excluded from reviews. However, the different approaches to nutrition education included in this review should be equally affected by this bias. Therefore, if one approach is more successful than another it is more likely to reflect the increased efficacy of the nutrition education program than a failure to include unpublished studies.

Method

The PubMed database was searched on the 17th of January 2009, using the terms (work or workplace or worksite) and (intervention or program) and (diet or nutrition or weight) in order to capture all potentially relevant studies. This search was limited to studies published in English between 1999 and 2008 and research involving human participants. A total of 1091 study references were identified using these criteria. Of these, 43 included a nutrition education program in the workplace, included healthy individuals (as opposed to targeting already unhealthy or high-risk employees), provided an evaluation of the program over time (i.e., not baseline data alone), and examined nutrition or health outcomes. Consequently, the studies reported here were repeated measures, controlled trials, unless otherwise reported in the results. An additional 5 studies were identified as part of a larger review that included exercise interventions in the workplace. Although nutrition was not the primary focus of these interventions, nutrition education was a significant component of the programs. Therefore, 48 studies were included in this review.

The results of these studies are summarised in Table 1. A description of the participants, the country in which the study took place and the number of

participants in the study, including controls, is included in Table 1. In addition, whether participation was compulsory for all employees or voluntary is specified under population, for studies that provided this information. The duration of the intervention, and whether a post-test was conducted at the end of the intervention are also indicated. In the table of results, maintenance reflects the maintenance of any effects observed at the end of the intervention at a later follow-up period. For example, three months would indicate that an evaluation of the program was conducted at the end of the intervention and three months after the end of the intervention. The results reported were statistically significant unless indicated otherwise in Table 1

Results and Discussion

Approaches to Nutrition Education – What works?

The nutrition education undertaken in the studies in this review included a number of different approaches; seminars, health screening, individual counselling, web-based nutrition education, workplace nutrition changes and peer-based interventions. Health screening or medical examinations were incorporated into a number of the health promotion programs providing the opportunity to monitor biological and physiological indices of health, specifically, BMI, blood pressure, and cholesterol (Aldana, et al., 2002; Braeckman, et al., 1999; Gordon, et al., 2001; Prior et al., 2005; Renaud, et al., 2008; Talvi, et al., 1999; Williams, et al., 2004). This approach, although potentially expensive, allows objective health indicators to be obtained. The inclusion of biological markers of health is useful, particularly if the health assessments can be integrated into existing workplace practices, although their utility is likely to be poor where the intervention is minimal or the duration short. Under these circumstances, significant effects are unlikely to be observed. Other studies focused on self-report measures of attitudes, perceptions, knowledge and behaviour, including dietary choices.

Several health promotion programs included individual counselling in their interventions (Atlantis, et al., 2006; Braeckman, et al., 1999; Elliot, et al., 2004; Moy, et al., 2006; Proper, et al., 2003; Sorensen, et al., 2007; Talvi, et al., 1999). Individual counselling allows nutrition advice to be tailored to the individual's needs and usually identifies barriers to dietary change. The aim of the counselling was generally described as setting behavioral goals that were specific to the individual. The advantage of this sort of approach is that it

makes the intervention personally salient although the costs are high in time and money.

Web-based interventions have also been utilized to provide tailored nutrition recommendations and feedback (Block et al., 2004; Brug, 1999; Campbell et al., 2002; R. F. Cook et al., 2007; Cousineau et al., 2008; De Bourdeaudhuij et al., 2007; Papadaki and Scott, 2008; Petersen et al., 2008). These programs collect information from individual participants and then provide targeted advice for the individual based on the information provided. Web-based nutrition education programs have been shown to decrease dietary intake of fat, junk foods, pre-packaged foods and increase intake of fruits and vegetables, fish, whole grains and water (Block et al., 2004; Brug, 1999; Campbell et al., 2002; De Bourdeaudhuij et al., 2007; Papadaki and Scott, 2008; Petersen et al., 2008). In addition, they have been shown to increase knowledge about nutrition, improve attitudes towards healthy eating, and reduce weight and cholesterol (R. F. Cook et al., 2007; Cousineau et al., 2008; Papadaki and Scott, 2008; Petersen et al., 2008). However, only two of these studies evaluated the outcomes after the intervention ended (Papadaki and Scott, 2008; Petersen et al., 2008) and only three studies compared a web-based delivery with alternative interventions (Brug, 1999; R. F. Cook et al., 2007; Papadaki and Scott, 2008).

Web-based programs present a number of distinct advantages. They mimic the tailored advice provided through counselling in a cost-effective manner. They are widely accessible and do not limit participation to workers in the same physical location. Therefore, these approaches would be suited to workers distributed across different cities or countries, those located in rural areas and those who work from home. In addition, many more traditional programs have supplemented education seminars or activities with emails, online newsletters, or health promotion websites to disseminate information (Plotnikoff et al., 2005; Polacsek et al., 2006).

Peer education programs utilise a less formal method for spreading nutrition messages. This approach identifies key individuals who disseminate the health promotion message by undertaking informal conversations with their peers. These peer educators, like web-based programs, are able to provide tailored nutrition information and advice but are also able to lead by example and take advantage of existing social networks. The Arizona 5-a-day Peer Education Program utilized this approach and found that the program led to increased consumption of fruits, vegetables, and juices and that these changes were associated with contact with peer educators (Buller et al., 2000; Buller et al., 1999). Although, most of the dietary changes were no longer significant 6

months after the program's conclusion, positive changes in nutrition knowledge and diet-related attitudes persisted at the 6 month follow-up.

The Coronary Heart Improvement Project evaluated by Aldana et al. (2005) was among the most effective interventions in that it not only achieved dietary change but these changes translated into a significant reduction in BMI in employees over a six-month period. The Coronary Heart Improvement Project included education sessions on a range of topics including obesity, coronary heart risks, cancer, diet, exercise, behaviour change, and self-worth. It also incorporated input from dietitians and medical professionals, utilized textbooks and workbooks and contained practical skills training during tours of supermarkets and cooking demonstrations. Although this intervention did not use a particularly innovative approach, it was a comprehensive and well planned program.

Other studies achieved differences in BMI but did not include a maintenance period in their research design (Aldana et al., 2002; Leslie et al., 2002). Talvi et al. (1999) found a reduction in BMI but only in men for two interventions: counselling, and written feedback and instructions based on a health examination. Petersen et al. (2008) also found a reduction in weight as a result of an online weight management program that persisted during a 6 month maintenance period. However, this study did not use a control group. An evaluation of the program after a 12 month maintenance period with a control group did not find a significant difference in the weight of those who participated in the program.

Table 1. Results from health promotion interventions, including nutrition education programs

REFERENCE	POPULATION (Sample, Country, N, recruitment)	INTERVENTION	DURATION	POST- TEST	MAINTENANCE	RESULTS	COMMENTS
(Block et al., 2008)	Employees of a health care organization U.S.A. 787 participants (549 at post-test) Voluntary participation	Email intervention Individualized feedback, goals, reminders and promotion of social support Targets: increasing physical activity, intake of fruits and vegetables, and decreasing dietary fats and sugars	4 months	✓	✗	Improvement in stage of change for fats and fruits and vegetables, self- efficacy for dietary change	Dietary changes not measured
(Chen, Wu, and Gu, 2008)	Steel factory employees China 110, 000 employees	Set-up health networks, health education and promotion, and training for health professionals Targets: moderate drinking, overweight and obesity, nutrition (reduced salt and fat content) along with smoking cessation, and physical activity	9 years	✓	✗	↓ salt intake, diastolic blood pressure	Fat intake not reported

Table 1. (Continued)

REFERENCE	POPULATION (Sample, Country, N, recruitment)	INTERVENTION	DURATION	POST- TEST	MAINTENANCE	RESULTS	COMMENTS
(Cousineau, Houle, Bromberg, Fernandez, and Kling, 2008)	Gaming establishment employees U.S.A. 54 employees Voluntary participation	Tailored nutrition Web program (<i>Working on My Health: Nutrition</i>) Nutrition assessment, information and strategies	30 minutes	✓	✕	↑ in nutrition knowledge	No control group Prototype of program
(Papadaki and Scott, 2008)	22-55 y.o. female, university employees Scotland 72 employees Voluntary participation	Tailored dietary feedback and goal setting, internet education (Mediterranean eating website) vs. minimal dietary feedback and general nutrition brochures	6 months	✓	3 months	Post-test: ↑ fruits, nuts, seeds, vegetables ↑ HDL cholesterol ↓ total: HDL cholesterol ratio Maintenance at 3 months: ↑ vegetables ↑ HDL cholesterol ↓ total: HDL cholesterol ratio	

REFERENCE	POPULATION (Sample, Country, <i>N</i> , recruitment)	INTERVENTION	DURATION	POST- TEST	MAINTENANCE	RESULTS	COMMENTS
(Petersen, Sill, Lu, Young, and Edington, 2008)	IBM employees U.S.A. 7743 employees (1639 at 6 months follow-up) Voluntary participation	Interactive online weight management program (Virtual Food Pro) Targets include dietary habits and physical activity	Self-paced	No distinct end point because the program was self- paced	6 months	↓ weight ↓ junk food, fast food, pre- packaged food, dessert, and non-fast food restaurants ↑ fish, whole grains, water, fruit, legumes, vegetables, and dairy ↑ eating breakfast and bringing lunch to work	No control group
					12 months	No significant difference in weight but significantly more in normal weight range in the intervention group	Control group

Table 1. (Continued)

REFERENCE	POPULATION (Sample, Country, <i>N</i> , recruitment)	INTERVENTION	DURATION	POST - TEST	MAINTENANC E	RESULTS	COMMENTS
(Renaud et al., 2008)	Employees of a financial organisation Canada 270 employees Voluntary participation	Take care of your health! program Educational sessions, health status profiles, voluntary telephone follow-up interviews Targets: global health, stress management, heart health, healthy eating and physical activity	3 years	✓	✗	↑ healthy eating habits such as 3 serves of fruits or fruit juices, 3 serves of vegetables or vegetable juices, eating whole-grain cereal products every day, limiting fat intake 34% reported losing weight	No control group
(R. F. Cook, Billings, Hersch, Back, and Hendrickson, 2007)	Human resources company employees U.S.A. 480 employees (419 at post- test) Voluntary participation	Web-based multimedia health promotion: diet, stress, and PA vs. print health promotion	3 months	✓	✗	No difference between the groups except the web- based intervention had greater improvement on attitudes toward a healthful diet and dietary stage of change Both groups showed improvements in diet and achieved a small amount of weight loss (pre- post within group	NB: comparison with print rather than no intervention

REFERENCE	POPULATION (Sample, Country, <i>N</i> , recruitment)	INTERVENTION	DURATION	POST - TEST	MAINTENANC E	RESULTS	COMMENTS
(De Bourdeaudhuij, Stevens, Vandelanotte, and Brug, 2007)	Employees of companies that showed interest Belgium 539 employees (337 at 6 month follow-up; voluntary)	Fat intake program Interactive computer tailored intervention vs. generic intervention (non-tailored advice) vs. no intervention	Not specified	✓ (6 months after baseline measurements)	✗	comparisons) fat intake	
(Sorensen et al., 2007) and (Sorensen et al., 2005)	Employees from small businesses that employed a multi-ethnic workforce U.S.A. 974 employees (completing baseline and follow-up) Voluntary participation	Healthy directions small business study Targeted to each worksite Individual behaviour change, environmental support, and organisational change Targets: healthy eating, physical activity, smoking cessation and reduction of hazardous occupational exposures	18 months	✓	✗	↑ Multivitamin use ↑ fruit and vegetable consumption was associated with supportive social norms, food sufficiency, and strong social networks	

Table 1. (Continued)

(Atlantis, Chow, Kirby, and Fiatarone Singh, 2006)	Casino employees Australia 73 employees (42 at post-test) Voluntary participation	Supervised exercise program Behaviour modification strategies (group seminars, one-on-one counselling, worksite manual) Dietary component: encouraged to decrease servings of energy dense foods,	24 weeks	✓	✗	↓ waist circumference No change in BMI No results given for dietary changes	
(Engbers, van Poppel, Chin, and van Mechelen, 2006)	Government office workers with a BMI>23 Netherlands 515 employees (432 at post-test) Voluntary participation	FoodSteps Intervention Food intervention: information sheets near food in the canteen, information on vending machines, information stand on healthy food, blood pressure, and cholesterol. The energy value of foods was translated into the number of minutes to perform a work activity to burn this energy. Focus on food (healthy food choices) and physical activity	12 months	✓	✗	¼ of the way through (3 months from baseline): Intervention led to more perceived social support in eating less fat No significant effect on fruit, vegetable, and fat intake Post-test: As above	

(Moy, Sallam, and Wong, 2006)	Male security guards working at a public university Malaysia 186 employees (150 at post-test) Voluntary participation	One to one counselling at least twice a year, group teaching (3-4) times a year, supportive environment Dietary advice was based on the National Cholesterol Education Programme (NCEP) Step 1 diet and the American Heart Association guide for improving cardiovascular health	24 months	✓	✕	↓ cholesterol No change in BMI, blood pressure, glucose No significant differences in dietary measures	
(Polacsek, O'Brien, Lagasse, and Hammar, 2006)	Worksite and community based intervention U.S.A. 1860 employees Voluntary participation	Move and Improve Various forms of communication (e.g. newspaper, online newsletter) including information on nutrition Focus on physical activity	12 weeks	✓	✕	Substantial proportion of participants reported ↓ weight, fat intake, television viewing, sugar-sweetened soft drink consumption, stress and ↑ intake of fruit and vegetables, energy, and water intake. Significance not reported.	Primarily a physical activity intervention Worksite and community based intervention

Table 1. (Continued)

(Yancey et al., 2006)	Organisations, businesses and agencies in target areas of LA (staff, members, and clients) Targeted African Americans and Latinos U.S.A. 565 employees	Cardiovascular disease prevention Diabetes prevention Exercise breaks and lectures and discussions on: goal setting and motivation, nutrition, physical activity/fitness	12 weeks	✓	✕	↑ intake of fruit and vegetables ↓ feelings of sadness or depression Trend ↓ BMI (p = .08)	No control group
(Aldana et al., 2005)	Medical care provider employees U.S.A. 145 employees (137 at 5 month maintenance period) Voluntary participation	Coronary Heart Improvement Project Education on health, diet, exercise, and behaviour change Input from dietitians, medical professionals, a textbook, workbooks, assignments, shopping tours and cooking demonstrations	4 weeks		2 weeks (6 weeks from baseline) 5 months (6 months from baseline)	↓ calories from fat ↑ carbohydrates, fruit and veg ↓ BMI, weight, cholesterol ↓ calories from fat, fat intake, dietary cholesterol, protein, servings of meat ↑ carbohydrates, fruits and vegetables ↓ BMI, weight	

(Plotnikoff, McCargar, Wilson, and Loucaides, 2005)	Employees from 3 government and 2 private sector organisations Canada 2121 employees Voluntary participation	Weekly emails with physical activity and nutrition messages Nutrition information: balance, variety and moderation, reducing fat intake, increasing fruit and vegetable intake	3 months		1 week (post-intervention)	Intervention group reported increased healthy eating practices, improved balance between food intake and physical activity, cooking meals with techniques to reduce fat and avoiding high-fat foods	
(Prior et al., 2005)	Employees from 162 companies Switzerland 4198 employees Voluntary participation	Reduction of cardiovascular risk factors Mobile unit Health screening, cardiovascular risk assessment, counselling if mildly elevated risk factors	15 mins	NA	3.7 years (on average because different companies had different maintenance periods)	↓ diastolic blood pressure ↑ BMI, body weight ↑ cholesterol in women and no change in men	Very brief intervention No specific nutrition education described

Table 1. (Continued)

(Block, Block, Wakimoto, and Block, 2004)	Corporate worksite employees U.S.A. 84 employees (47 at post-test) Voluntary participation	Worksite Internet Nutrition (WIN) Tailored to the individual Choice between reducing fat or increasing fruit and vegetables Skill facilitation Goal setting, reminders and reinforcement Family participation and support, information, social networks (bulletin board) and links to websites	12 weeks	✓	✕	↓ dietary fat ↑ fruits and vegetables	Only 56% participated in the evaluation at the end of the program Results remained significant when a change score of 0 was assigned to non-responders
(Elliot et al., 2004)	Professional firefighters U.S.A. 33 firefighters	Promoting Healthy Lifestyles: Alternative Models' Effects (PHLAME) Team based intervention vs. client centred (individual meetings with trained health counsellor) vs. control Increase servings of fruit and veg, physical activity, energy balance, reduce fat intake and normalize body fat	6 months	✓	✕	Both interventions: ↓ LDL cholesterol Team: ↑ coworker cohesion, personal exercise habits, coworkers' healthy behaviours One-on-one: ↑ dietary self-monitoring, ↓ fat intake, depressed feelings	

(Gill and Wijk, 2004)	Professional drivers passing through truck stops Sweden 120 drivers Voluntary participation	National healthy eating intervention Information campaign Offering healthy food choice alternatives Menu changes (presentation and content) Truck stop food content Training of staff Incentives for healthy choices (tokens for prizes and a lottery)	3 years	✓	×	↑ nutritional awareness ↑ in healthier food choices by drivers (qualitative data) Specials were more balanced in terms of fat, calories, carbohydrates and protein content	No control group Evaluation was conducted using interviews, field observations, and questionnaires
(Holdsworth, Raymond, and Haslam, 2004)	Employees from various workplaces England 1153 employees (577 at post-test)	Heartbeat Award scheme Information, reminders and reinforcement for behaviour change Supportive environment Nutrition goals: reduce fat, sugar and salt and increase fibre-rich, starchy foods		✓	×	Significantly more positive change in 4 out of 20 foods tested: ↑ fruit, ↓ fried food and sweet puddings, and change to low fat milk	Baseline data was taken 6 months prior to the Heartbeat Award scheme
(Shimizu, Horiguchi, Kato, and Nagata, 2004)	Employees from manufacturing companies Japan 629 employees	Health interviews, measurements and group education on nutrition, exercise and stress management	4 years	✓	×	↓ BMI and systolic blood pressure in under 35 year olds ↓ Serum total cholesterol, HDL cholesterol in over 35 year olds	

Table 1. (Continued)

(Steenhuis et al., 2004)	Employees (mostly white collar) from large Dutch companies The Netherlands 1013 respondents (completed both pre and post-test)	Cafeteria interventions Compared an educational program (eating less fat, more fruits and vegetables) a food supply program (increased availability of healthy foods), a labelling program (labelling of low fat products) and a control group (no program) Fat, fruit and vegetable intake	4 weeks	✓	✗	Labelling program led to ↓ fat intake for participants who believed they ate a high fat diet and ↑ sales of low fat desserts	
(Williams, Wold, Dunkin, Idleman, and Jackson, 2004)	Low-income African American female employees at urban and rural worksites U.S.A. 294 employees Voluntary participation	Diet and physical activity behaviour change to reduce risk of cardiovascular disease		✓		↓ % with elevated cholesterol ↓ dietary fat intake in rural women	No control group

(Abood, Black, and Feral, 2003)	University employees U.S.A. 33 employees Voluntary participation	Nutrition education program Weekly 1 hour education sessions from a dietitian for 8 weeks Promotion of knowledge and beliefs to improve diet for cancer and cardiovascular disease (CVD) Tailored by baseline assessments and addressed perceived benefits and barriers	8 weeks	✓	×	↑ perceived benefits of positive dietary behaviours ↑ knowledge about nutrition and CVD and cancer prevention ↓ energy intake, fat and cholesterol intake	
(Proper, Hildebrandt, Van der Beek, Twisk, and Van Mechelen, 2003)	Employees from municipal services The Netherlands 299 employees Voluntary participation	Individual counselling on physical activity, fitness and health Content derived from the Patient-centred Assessment and Counselling for Exercise and Nutrition (PACE) program Enhancement of physical activity and promotion of healthy nutrition habits	9 months	✓	×	↓ % body fat and cholesterol	No specific dietary changes measured or reported

Table 1. (Continued)

(Aldana, Greenlaw, Diehl, Englert, and Jackson, 2002)	Employees from various metropolitan companies U.S.A. 453 employees Voluntary participation	Coronary Health Improvement Project (CHIP) video program Health screen, individual recommendations from a nurse, 8 weeks of education delivered by video and facilitators Topics included dietary fibre, dietary fat, cholesterol, hypertension, diabetes education, cancer, and the optimal diet	8 weeks	✓	✗	↓ BMI, weight, systolic and diastolic blood pressure, total cholesterol, HDL cholesterol, LDL cholesterol, triglycerides, and fasting blood glucose.	No control group
(Campbell et al., 2002)	Rural, female, blue-collar employees (manufacturing industries) U.S.A. 859 employees (660 at 6-months and 650 at 18 months)	Health Works for Women (HWW) Individualized computer-tailored health messages Natural helpers program (volunteers from the workplace who enhance social support, promote activities, and share information) Physical activity, diet, smoking, breast and cervical cancer screening	18 months	✓	✗	1/3 way through (6 months from baseline): ↓ fat score Post-test: ↑ fruit and vegetables	

(Leslie, Lean, Baillie, and Hankey, 2002)	Male employees at a petrochemical worksite Scotland 122 employees (91 at post-test) Voluntary participation	Compared energy deficit diet with meat, energy deficit diet with no meat, low calorie diet with meat, and low calorie diet with no meat Dietary advice, eating plan	12 weeks	✓	×	No diffs between the groups Both groups combined: ↓ weight, BMI, waist, total cholesterol, LDL cholesterol, and triglycerides	
(Pegus, Bazzarre, Brown, and Menzin, 2002)	Employees from manufacturing worksites U.S.A. 663 employees Voluntary participation	Heart at Work program Exercise, low-fat diets, knowledge of risk factors	12 months	✓	×	↑ knowledge of nutrition, diet, heart attack risk factors and blood pressure. More likely to report planning to change to a lower-fat diet or lose weight ↑ % reporting weight loss	
(Sorensen et al., 2002, 2003)	“Blue-collar workers” from manufacturing worksites U.S.A. 5156 employees (completing both baseline and post-test) Voluntary participation	WellWorks-2 study Health promotion or health promotion with integrated OHandS	2 years	✓	×	No sig diff in fruit and vegetables	Comparing 2 intervention groups, no control group receiving a minimal intervention or no intervention at all

Table 1. (Continued)

(Beresford et al., 2001)	Employees at worksites with cafeterias U.S.A. 1681 employees (completing both baseline and post-test)	Seattle 5 a Day Worksite Program Targeted to each worksite Individual behaviour change, and work environment Interventions for increasing fruit and veg consumption			(2 years from baseline)	↑ servings of fruit and vegetables	
(C. Cook, Simmons, Swinburn, and Stewart, 2001)	Male, hourly paid, employees at manufacturing worksites New Zealand 153 employees (136 after 6 month maintenance period) Voluntary participation	30 minute workshop session, once a month for 6 months Nutrition displays Heath promotion messages Water and low-fat items made available Nutrition, non-communicable disease risk, safe use of alcohol, and physical activity	6 months	✓	6 months (12 months from baseline)	↑ in vegetable servings, nutrition knowledge ↓ in systolic blood pressure, fat score No (significant) change in BMI, waist circumference, fruit servings, alcohol	

(Gordon et al., 2001)	Employees at companies in 3 cities U.S.A. 1483 employees	INTER ₂ VENT Cardiovascular disease risk reduction Risk appraisal, assessment, goal-setting, action plan implementation, long-term follow-up, compliance tracking Actions included referral to a dietician, nutrition and dietary supplements, physical activity etc.	12 weeks	✓	×	↓ total cholesterol, LDL cholesterol, triglycerides, and fasting blood glucose level [Significantly greater reduction in cholesterol compared with physician-supervised nurse-care managed condition (different data set)]	No control group
(Parker et al., 2001)	U.S. Army War College U.S.A. (N not specified)	Voluntary, interactive, educational training on: dietary intervention, stress management, cholesterol reduction, diabetes education, hypertension control, aerobic and strength training and others CD-ROM for nutrition education, health habits, aerobics and other areas and provided a tailored program				No change in BMI Lower cholesterol than age-matched peers in the community Less than 2% of men and 4% of women exceed waist size recommendations	No control group Compared with rates in general population

Table 1. (Continued)

(Pescatello et al., 2001)	Hospital employees U.S.A. 621 employees (278 over the 4 year intervention) Voluntary participation	Cardiovascular heart awareness program (CHAP) Cardiovascular screen, results counselling, alone (CHAPonly) vs. cardiovascular screen, results counselling, structured health education and behavioural support program (CHAPplus)	4 years	✓	✕	No significant differences between two groups of participants CHAP program led to improvements in blood glucose, LDL cholesterol and total cholesterol to HDL ratio	CHAPplus participants took part in exercise, nutrition and weight management, smoking cessation, OR cardiac rehabilitation programs. Therefore, some participants may not have participated in nutrition education
(Buller et al., 2000)	Public sector employees (e.g. government, public school, university employees) U.S.A. 331 employees (314 at 6 month maintenance period) completed evaluations	Arizona 5-a-day Peer Education Program Individuals who were central to social groups were trained as peer educators Peer educators engaged in nutrition education for 2 hours/week with co-workers Resource guide, newsletter, and enabling gifts (recipe book, seeds)	9 months	✓	6 months	Post-test: Contact with peer educators was associated with increases in fruit, vegetable and juice consumption Maintenance at 6 months: Contact with peer educators was associated with increases in fruit juice consumption	See Buller 1999 for direct impact on diet

(Holdsworth, Haslam, and Raymond, 2000)	Various workplaces England 1153 (577 at post-test) Voluntary participation	Heartbeat Award Scheme Reduction of coronary heart disease rates Nutrition goals: reduce fat, sugar and salt and increase fibre-rich, starchy foods	6 months	✓	×	↑ healthy eating information and availability of healthy foods at work No significant change in nutritional knowledge	
(Biener et al., 1999)	Employees from various worksites (manufacturing, communication, public service, and utilities) U.S.A. 20, 801 employees (18, 205 at follow-up after 3 years)	Working Well Trial Multi-site Targeted eating patterns at the individual level as well as changing the food environment (along with smoking and other risk factors)			(3 years from baseline)	↑ access to fruits and vegetables at work, ↑ access to nutrition information at work, ↑ nutrition labelling and changes in vending machines	
(Braeckman, De Bacquer, Maes, and De Backer, 1999)	Predominantly “blue-collar” male employees, aged 35-59, from Belgian worksites Belgium 770 employees (638 at post-test) Voluntary participation	Nutrition education program Health screening, individual counselling and feedback Information, posters, video, 2 hour education session and a newsletter Targets: lowering fat and cholesterol	3 months	✓	×	↑ nutrition knowledge ↑ proteins and carbohydrates ↓ total calories and % of energy from fat Only ↓ cholesterol in those with hypercholesterolemia	

Table 1. (Continued)

(Brug, 1999)	Employees of an oil company, a health care organisation and healthy volunteers (results from three studies combined) The Netherlands 1309 participants	Computer-tailored nutrition advice) vs. tailored feedback letters vs. general non-tailored feedback letters		✓	✕	Computer-tailored advice: ↓ fat scores from pre to post assessments (not significantly different from other groups) Tailored advice (computer or letter): more likely to read and discuss the nutrition advice	Employees and community sample
(Buller et al., 1999)	Employees from a multicultural, lower-income population U.S.A. 2091 employees (695 at post-test) Note: 1523 employees not randomized because not in a “clique” eligible for peer education Voluntary participation	Five a Day Education Program with a peer health education program vs Five a Day Education Program alone Workplace mail, cafeteria promotions, and speakers Peer educators identified using social network analysis Peer educator training Informal conversations with peers about eating fruits and vegetables	18 months	✓	6 month	Post-test: ↑ fruits and vegetables ↑ awareness of the 5 a Day program, knowledge of appropriate number of servings of fruit and veg Improved diet-related attitudes (e.g. eating fruit and vegetables is important to me) Maintenance at 6 months: Total number of servings, awareness of the 5 a Day program, knowledge of appropriate number of servings of fruit and veg per day persisted Some diet-related attitudes Perception that fruits and vegetables = easy to get at work	

(Emmons, Linnan, Shadel, Marcus, and Abrams, 1999)	University School of medicine/hospital employees U.S.A. 2291 employees	Working health project/working well trial Workers participated in design and implementation Nutrition, smoking and physical activity Nutrition focused on fat, fibre, fruits and vegetables	2.5 years	✓	✗	small ↑ fruit and veg, ↑ fibre No diffs in fat intake between the intervention and control groups	
(Fries, Ripley, Figueiredo, and Thompson, 1999)	Employees of rural manufacturing companies U.S.A. 217 employees (184 employees at post-test) Voluntary participation (although some information distributed to all employees)	Intervention on smoking and diet Posters, dietary information, cancer prevention library, computerised dietary fat screening with personalised dietary feedback, nutrition seminar	9 months	✓	✗	↑ reported likelihood of reducing dietary fat and confidence of doing so ↑ servings of fruit and vegetables ↑ perceived support at work for reducing fat intake	No control group

Table 1. (Continued)

(Sorensen et al., 1999)	Employees from health centres U.S.A. 1359 employees (1306 at 1-2 month maintenance period)	Treatwell 5-a-day study Minimal intervention vs. worksite vs. worksite with family involvement 5-a-day media campaign, promotion of the Cancer Information Service Hotline, 1 hour nutrition presentation and taste test at the worksite Work: Individual behaviour change and changes in the worksite environment Family: “learn at home program”, annual family newsletter, annual family festival, materials mailed to families	19.5 months		1-2 months (22 months post-baseline)	↑ fruit and veg in intervention groups after controlling for gender, education, occupation, race/ethnicity, and living situation Change was largest in work + family support intervention.	
(Talvi, Jarvisalo, and Knuts, 1999)	Employees of two oil refineries Finland 885 employees (798 at 3 years) Voluntary participation	Group A: counselling Group B: feedback and instructions given in written format For those with goals relating to diet there was a lecture covering energy intake and consumption, BMI, metabolism and healthy cooking Physical activity, dietary habits, obesity, blood pressure, serum lipids and smoking Health examination Health goals			(3 years from baseline)	↓ BMI in men in both groups and ↑ BMI in women in group B ↓ HDL-cholesterol in men in both groups and women in group B ↓ serum cholesterol in men in group B	

Note: Maintenance period refers to the time of evaluation in terms of the number of weeks or months after the intervention finished.

Problems Experienced in Delivering Workplace Programs

Retention

Retaining participants in nutrition education or health promotion programs was a challenge for several programs. Despite the importance of this issue, many studies did not report retention rates in their papers. Where they were reported, levels of drop-outs were sometimes high. For example, Holdsworth et al. (2000) and Block et al. (2004) reported that only 50% and 56% of participants completed all stages of their respective programs, including all of the evaluations. On the basis of these participation rates it is important to observe that even if these nutrition education programs significantly improve the health and wellbeing of some employees, these effects may not generalize to the whole workforce. Participation in nutrition education sessions is often on a voluntary basis and as such, caters for people who are already interested in nutrition and/or motivated to change their health behaviour. Thus, these interventions do not reach people who are less motivated and who may stand the most to gain from nutrition education. The specific reasons for low retention rates should be determined in order to make nutrition education interesting and relevant to a larger number of people. In addition, it is important to remember that the results from program evaluations may be amplified if they only include those who like the program and therefore, complete the program, in the assessment of the program's outcomes.

Program Duration and Long-Term Change

The majority of the nutrition education or health promotion programs were evaluated at their conclusion without any further follow-up (Abood et al., 2003; Aldana et al., 2002; Atlantis et al., 2006; Block et al., 2004; Braeckman et al., 1999; Brug, 1999; Campbell et al., 2002; Chen et al., 2008; R. F. Cook et al., 2007; Cousineau et al., 2008; Elliot et al., 2004; Emmons et al., 1999; Engbers et al., 2006; Fries et al., 1999; Gill and Wijk, 2004; Gordon et al., 2001; Holdsworth et al., 2000; Leslie et al., 2002; Moy et al., 2006; Pegus et al., 2002; Pescatello et al., 2001; Polacsek et al., 2006; Proper et al., 2003; Renaud et al., 2008; Shimizu et al., 2004; Sorensen et al., 2002; Sorensen et al., 2003; Sorensen et al., 2005; Sorensen et al., 2007; Steenhuis et al., 2004;

Yancey et al., 2006). As a result, the extent to which dietary changes were maintained over time is unknown. Furthermore, several studies did not explicitly state the duration of their interventions, making it unclear whether the evaluations were conducted during the intervention period, at its conclusion, or at a later follow-up (Beresford et al., 2001; Biener et al., 1999; De Bourdeaudhuij et al., 2007; Guico-Pabia, Cioffi, and Shoner, 2002; Holdsworth et al., 2004; Kristal, Glanz, Tilley, and Li, 2000; Parker et al., 2001; Talvi et al., 1999; Williams et al., 2004).

Despite these limitations, a few studies evaluated the programs 6 months after their completion (Aldana et al., 2005; Buller et al., 2000; Buller et al., 1999; C. Cook et al., 2001; Muto and Yamauchi, 2001; Sorensen et al., 1999). In general, these studies had encouraging results with increased fruit and vegetable consumption (Aldana et al., 2005; Buller et al., 2000; Buller et al., 1999; C. Cook et al., 2001; Sorensen et al., 1999), decreased fat and red meat intake (Aldana et al., 2005), reduced blood pressure (C. Cook et al., 2001), and cholesterol (Aldana et al., 2005). Buller et al. (1999) found that while some effects persisted after 6 months (awareness of the program, knowledge of the appropriate number of daily servings of fruit and vegetables) others did not, such as increased consumption of fruit and vegetables. This study indicates that behavioural change may be more difficult to maintain over time than changes in knowledge and awareness.

In addition, there were conflicting results regarding BMI. Although Cook et al. (2001) found no difference in BMI or waist circumference, some of the studies with a pre-test post-test design without long term follow-up, found significant reductions in BMI (Aldana et al., 2002; Leslie et al., 2002) and Aldana et al. (2005) found reduced BMI after a 5 month maintenance period. In contrast, one study (Prior et al., 2005) had a follow-up period of over three years and found reduced diastolic blood pressure but found increases in BMI and weight in men and women, and an increase in cholesterol in women. Although this is discouraging in terms of long term change this intervention was very brief. It is not clear whether inconsistent results with respect to BMI are due to differences in the programs that were implemented or differences in the program participants.

In sum, there is limited evidence of long term change as a result of nutrition education and health promotion programs in the workplace. However, this may result from the study designs that have been utilised and the small number of studies with extensive longitudinal follow-up. Future studies should endeavour to follow-up participants over a period of months, and possibly years, because nutrition education aims to improve or change

eating habits in the long-term. Nutrition education programs may need to consider additional sessions, updates or different approaches for keeping employees motivated, to maintain the changes that are achieved over a longer period of time.

Study Design

The benefits of nutrition education programs can be difficult to determine due to the manner in which they are evaluated. Many of the studies included in the current review did not include a control group and therefore would not meet minimal requirements for evaluation of program efficacy. Without a control group it is not possible to determine whether changes in dietary habits have resulted from factors such as the participants' awareness that they were being studied, health promotion efforts in the community such as media campaigns, or seasonal changes, such as increased caloric intake in autumn and decreased intake in spring (Ma et al., 2006). A control group would account for these possibilities because control participants would also have been aware of their involvement in research, they would have been exposed to other health promotion efforts, and may have participated at the same time of year as those in a nutrition education program. The inclusion of a control group is therefore a basic requirement for good internal validity and, consequently, demonstration of program efficacy.

In addition, some studies relied primarily on self-report measures of diet, while others included health outcomes, which should reflect dietary behaviour, such as cholesterol and BMI. A reliance on the former, alone, as the main outcome of the interventions raises the possibility of "social desirability bias" confounding the outcome (Fisher, 1993). Participants may want to make a good impression by being seen to do the "right" thing (e.g. eat more fruits and vegetables) and not to do the "wrong" thing (e.g. consume foods that are high in fat) and respond accordingly on self-report measures. Furthermore, health outcomes may not reflect dietary changes accurately because changes in BMI and cholesterol may not be seen straight away and other aspects of health may affect these outcomes such as thyroid disorders and diabetes. Ideally, both forms of measurement should be included. Despite their limitations, if self-report measures and health measures yield consistent results, the intervention is more likely to have resulted in significant change.

Multiple Health Behaviours

Nutrition education was not necessarily the primary focus of the health promotion programs that were evaluated by the studies included in this review, although it was an important component of these programs. The majority of the interventions targeted more than one health behaviour such as diet, physical activity, and smoking. There is growing evidence that interventions that target multiple health behaviours are equally or more effective than those that target single health behaviours (for a review refer to Prochaska, Spring, and Nigg, 2008). This may be because unhealthy behaviours often co-occur. That is, people who have an unhealthy diet may also be physically inactive and smoke. Similarly, achieving change in one area of health may lead to increased confidence in one's ability to improve behaviour in another (Prochaska et al., 2008). Therefore, change to unhealthy behaviours may also co-occur. Interventions that focus on multiple health behaviours also make sense on a practical level due to the expense and time involved in health promotion.

New Areas of Investigation

Studies described in this review have tended to focus on a limited number of mechanisms for achieving behaviour change; education delivered through a variety of methods (information sheets, telephone, computer, face-to-face etc), individual feedback and goal setting, counselling and use of peer educators and social support.

Only a very few studies looked to employer-initiated, fundamental changes to the worksite as a way to ameliorate environmental barriers to behaviour change. These sorts of initiatives have been defined by Glanz et al. (1996) as those strategies that do not require individuals to self-select into defined educational programs. Examples of such initiatives tend to generally focus on top-down alterations to the entire workplace environment. They include studies in which healthy foods are made more accessible and information about their value is provided (Biener et al., 1999; Dawson, Dwyer, Evers, and Sheeshka, 2006; Engbers et al., 2006; Gill and Wijk, 2004; Steenhuis et al., 2004). These approaches go some way towards addressing the recommendations of the International Labour Organisation (ILO) who, in 1956 promulgated the Welfare Facilities Recommendation (No. 102), in which guidelines for the establishments of work place canteens were provided. Although the original focus of the ILO was on malnutrition, in the current

context, workplace practices that address over-nutrition could assist in alleviating concerns with employee overweight. A recent expert report on cancer prevention from the World Cancer Research Fund (2009) recommends that workplaces encourage healthy eating habits by using incentives, removal of foods that are high in salt, sugar, or fat from vending machines, provision of healthy food options in cafeterias, and provision of nutrition education and information on disease prevention.

Some workplaces are already firmly committed to the establishment of an organisational climate that supports “healthy weight”. For example, a number of autoworker unions have successfully lobbied for employer supported food programs for their workers, with the Canadian Auto Workers achieving a “better meals” program for employees of Chrysler in 2001 and General Motors in 2004 (Wanjek, 2005). In Denmark, a small, employer-sponsored intervention in which free fruit was supplied to employees in 6 worksites and subsequent intake was compared between these and 6 control settings, proved so successful that by 2004, 9288 worksites were participating in like programs representing 9% of workplaces in Denmark (<http://6omdagen.dk/foredrag/2005VIEsymposiumMM3.ppt>).

Future studies might usefully further compare worksites where the environmental context is altered so that workplace practices support healthy dietary choices to the more traditional workplace setting. The precise nature of these changes might vary but they are likely to include employer subsidization of healthy food choices including, but not limited to, the removal of the sale of snack foods, provision of fruit and bottled water free of charge, and labelling of healthy food items.

Conclusion

Nutrition education is a central component to many health promotion programs that take place in the workplace. The workplace is a useful setting for providing information and support for healthy behaviours because many people spend a large amount of their time at work and it provides a context that can provide supportive social norms.

Although this review was limited to published studies, which may be biased towards studies with significant findings, the available evidence suggests that nutrition education in the workplace is successful in achieving improvements in diet. However, more longitudinal studies are necessary to support a reliable assessment of whether these programs achieve enduring

weight loss. Limited evidence indicates that interventions that utilise web-based approaches hold promise due to their accessibility and affordability. In addition, peer-based approaches, which take advantage of existing social networks, may appeal as an alternative to programs that appear driven by management. This review indicates that although nutrition education in the workplace leads to promising outcomes, further research is necessary to address issues of participant retention and long-term maintenance of changes to dietary habits.

The effectiveness of workplace based environmental interventions must be subjected to the same scrutiny of design, sample and effectiveness as that applied to small, one-off programs. However, it is also important to realise that translational research requires high level ecological validation as well as internal validation, and the two may conflict. In other words, a well-controlled study where confounds are minimised, where dependent and independent measures are well-defined and measured, and where treatments are not contaminated, may produce a significant effect, but it may be impossible to initiate this treatment in the “real-world” environment or to maintain it through time or across work settings and employee groups.

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