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Editorial

*Corresponding author
**Ahmad Alkhatib**, PhD, MSc, BSc/BA, FHEA, CISSN, RNutr, Fellow RSM
Head of Division of Sport and Exercise Science at Abertay University
School of Social and Health Sciences
University of Abertay Dundee
Bell Street DD1 1HG, UK
**Tel.** +44(0) 1382 308643
**E-mail:** a.alkhatib@abertay.ac.uk
**G-mail:** drahmadalkhatib@gmail.com

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# Prescribing Exercise as an Alternative Treatment for Ageing Populations of the 21st Century

**Ahmad Alkhatib, PhD***

*Division of Sport and Exercise Science, School of Social and Health Sciences, University of Abertay, Dundee, Bell Street DD1 1HG, UK*

Life expectancy has significantly increased over the past few decades. Since 1990, life expectancy at birth has increased by 6 years globally, and populations live on average 20 years longer than 50 years ago according to the latest WHO report on ageing.[1] The retirement age, currently average at 65 years, and is expected to rise to almost 70 years by 2060 in many developed countries (EU report, 2015). For example, the UK legislation is expected to rise the pension age to 68 by 2046.[1,2]

However, the positive income effects of governments' increase in retirement age have also had negative effects on increasing government health care expenditures.[3] For example, healthcare spent in USA has recently been reported as $4.6 trillion.[4] Chronic diseases in the UK cost the NHS £542 million for cardiovascular disease (CVD) and £158 million for type-II diabetes.[5] Therefore, implementing effective preventative measures for healthy ageing should consider cost-effective strategies, especially those involving drug-free and involve reduced number of hospital visits.

The process of ageing represents physical, psychological and social change, which makes the risks associated with ageing multi-faceted.[6] Age-related deleterious changes include physiological decline in cardiovascular system, a psychological cognitive decline, social isolation, and reduced quality of life. These effects also prompt manifestation of several chronic diseases including cardiovascular disease, hypertension, diabetes and cancer, which are major causes of mortality.

Given that physical inactivity is now an established risk factor for ageing and age-related chronic diseases,[2] the role of prescribing structured exercise or unstructured physical activity for older populations has become increasingly important to reverse those risks. Compared with sedentary or physically inactive older population, those who exercise regularly enjoy an improved quality of life and reduced health risks. However, despite the incontrovertible evidence from observational and randomised controlled trials about the exercise role as primary and secondary prevention of CVD and mortality risks, prescribing exercise as a preventative treatment is still under-utilised by health systems across the world.

In comparison to a drug treatment, exercise is a less costly and a more effective treatment for several age-related health conditions including diabetes, cancer, arthritis, and cardiorespiratory diseases.[7-9] The effectiveness of exercise interventions *versus* drug interventions on mortality risks has been recently compared in a meta-epidemiological study which included 305 randomised controlled trials involving almost 0.5 million participants.[10] The findings reported either better effectiveness or no difference for exercise interventions compared with drug treatments in three out of four mortality outcomes, which included secondary prevention of coronary heart disease, rehabilitation of stroke, treatment of heart failure, and prevention of diabetes.[10] While the case for recommending physical activity as a preventative therapy for all ages is essential, the prescription of physical activity as a treatment in high-risk older populations should be further implemented.

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Working with clinical high-risk populations should include prescribing a well designed and appropriately supervised exercise interventions that include components of health-related physical fitness such as cardiovascular fitness, musculoskeletal fitness, body composition and metabolism.[11,12] There has never been a better understanding of how to prescribe exercise effectively in terms of frequency, intensity, type and duration for a variety of clinical populations including high-risk obese, older and those diagnosed with a chronic disease. Appropriate health policies should support primary care specialists to include evidence-based physical activity in their prescription plan, particularly in older and high-risk populations.

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Editorial

*Corresponding author
**Mohammad Javad Hosseinzadeh-Attar, MD, PhD**
Associate Professor
Department of Clinical Nutrition
School of Nutritional Sciences and Dietetics
Tehran University of Medical Sciences
No#44, Hojjatdoost St., Naderi Ave.
Keshavarz Bld., Tehran, Iran
**Tel.** +00982188993059
**E-mail:** mhosseinzadeh@tums.ac.ir

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# Coenzyme Q10, Glucose Homeostasis and the Probable Mediating Role of Adipokines

**Mohammad Javad Hosseinzadeh-Attar, MD, PhD*; Elham Alipoor, MSc; Parvaneh Mehrdadi, MSc**

*Department of Clinical Nutrition, School of Nutritional Sciences and Dietetics, Tehran University of Medical Sciences, Tehran, Iran*

Coenzyme Q10 is one of the most popular nutritional supplements, which has been discovered in 1955. It is also known as ubiquinone, Q10, CoQ and vitamin Q10. This coenzyme has two isoforms; the oxidized form, ubiquinone, is an electron carrier in mitochondrial respiratory chain and the reduced form, ubiquinol, acts as an antioxidant.[1,2] Studies reported its beneficial effects in some diseases such as diabetes, heart failure, hypertension, and Parkinson disease.[3,4] Q10 has also been proposed to be helpful in prevention and treatment of neurodegenerative and mitochondrial related diseases.[5] Q10 could potentially be effective on metabolic disorders including lipid profile, blood pressure, glycemic control and insulin resistance in different diseases.[6-8]

Many diseases are accompanied with imapired glycemic control and insulin resistance.[9] Phosphorylation of Insulin Receptor Substrates (IRS) is crucial for insulin signalling cascade, which in turn activates the mitogen-activated protein kinase (MAP-Kinase) with major mitogenic effects and phosphatidylinositol-3-Kinase (PI-3K) with prominent metabolic properties including appropriate cellular glucose distribution.[10] Coenzyme Q10 might induce the tyrosine kinase and phosphatidylinositol 3 kinase (PI3k) activity in liver. These enzymes are involved in improving insulin cascade and increasing GLUT2 and tyrosine phosphorylation of IRS-1, which could in turn enhance glucose uptake and inhibit gluconeogenesis in liver.[11] This antioxidant has been shown to reduce HbA1C levels in experimental and clinical studies and to improve long term glycemic control.[6,7,12,13] It could also increase insulin production and secretion probably by stimulating ATP generation in pancreatic beta cells.[14] Other proposed mechanisms include regulation of insulin receptors, glucose transporters, lipid profile, redox system, and receptors of advanced glycated end products.[15]

Obesity, the major growing health problem worldwide, is one the most important contributors of initiation and progression of insulin resistance.[16] The potential mechanisms include higher production of fatty acids, activation of Toll-like receptor 4 and the innate immune system, alterations in endocrine and inflammatory mediators and activation of nuclear factor-κB (NF-κB).[17]

Recently the metabolic functions of adipose derived peptides, adipokines, have been investigated progressively in different disorders. The changes in the secretion of adipokines in obesity could inhibit insulin signalling through increasing inflammatory adipocytokines and other mediators interfering the IRS phosphorylation and integrity.[17] The relationship between the major adipokines, leptin, adiponectin, resistin and visfatin with glucose homeostasis has previously been demonstrated.[18,19] Leptin could contribute to glucose homeostasis through direct and indirect actions on peripheral tissues. Direct leptin actions might inhibit insulin and glucagon secretion from pancreatic cells. Moreover, leptin could potentially affect insulin signaling in adipocytes, liver and skeletal muscles. Central leptin actions on glucose homeostasis might be mediated through both the sympathetic nervous system and the parasympathetic nervous system in different tissues.[20] Resistin has primarily been known as an adipokine with adverse effects on insulin sensitivity. Resistin could activate NF-κB and induce the secretion of pro-inflammatory

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factors, which could be potentially involved in insulin resistance.[19] Visfatin has similar inflammatory characteristics; however, regardless of some controversies, it is proposed to have favourable effects on glucose metabolism.[21] Moreover, the reduction in adiponectin levels would be associated with insulin resistance, dyslipidemia, metabolic syndrome and atherosclerosis.[18] Modulating fatty acid oxidation, reducing hepatic gluconeogenesis and hepatic glucose production are among the proposed mechanisms.[22] Adiponectin could also activate adenosine monophosphate dependent kinase and peroxisome proliferator-activated receptor-α pathways.[18] There are also recently recognized adipokines with insulin sensitizing features like adipolin (CTRP12).[23] Adipolin improves insulin actions by suppressing the gluconeogenesis *via* PI3K-Akt pathway and improving glucose uptake of adipocytes and hepatocytes. It increases phosphorylation of IRS-1 and Akt in adipose tissue and liver while this effect is not observed in muscle cells.[23] Adipolin might also have anti-inflammatory effects. Adipolin administration have decreased macrophages accumulation and the gene expression of proinflammatory cytokines in experimental studies.[24]

There are obvious commonalities between the mechanisms of modulating glucose metabolism by adipokines and Q10. Nevertheless, despite the available data on the functions of adipokines on insulin signalling, there are few studies investigated the probable role of these peptides in mediating the beneficial effects of dietary supplements such as coenzyme Q10 on glucose homeostasis and insulin resistance. In a recent study, the possible underlying mechanisms of coenzyme Q10 supplementation were assessed in diabetic rats. Regardless of previously documented mechanisms, an increase in adiponectin receptors and levels, and a decrease in visfatin levels were observed.[15] Recently, we examined the effects of Q10 on serum adipolin levels and glycemic control of diabetic patients. We observed interesting and unexpected results that will be published soon. These kinds of studies could provide new insights into the possible role of adipocytokines in improving insulin signalling by coenzyme Q10 as a potential adjuvant treatment for conventional anti-diabetic therapies. Further studies investigating the unrecognized mechanisms of the interaction between coenzyme Q10 and adipokines in modulating glucose homeostasis are warranted.

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**CONFLICTS OF INTEREST**

Dr. Hosseinzadeh-Attar has nothing to disclose.

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Review

*Corresponding author
**CHU Chen-Yi, PhD**
Assistant Professor
Department of Physical Education
National Hsinchu University of Education
521 South Road, Nan-da Rd
Hsinchu City, Taiwan, ROC
**Tel.** 03 -5621525
**Fax:** 03 -5629174
**E-mail:** tammychu9203@gmail.com

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# Impacts of Lifestyle and Socioeconomic Status on Childhood Obesity

**LIN Kuei-Fu, PhD; CHU Chen-Yi, PhD***

*Department of Physical Education, National Hsinchu University of Education, Hsinchu City, Taiwan*

## ABSTRACT

Childhood obesity is an important indicator to predict adulthood obesity, so monitoring factors that contribute to childhood obesity plays a constructive role in preventing adulthood chronic diseases and metabolic syndrome. The present article attempted to analyze the impacts of lifestyle, sedentary activities, dietary habits and socioeconomic status on childhood obesity, and to provide recommendations for preventing childhood obesity. Research findings showed that childhood obesity results from increasing sedentary time, unhealthy eating behaviors and changes of healthy environment. TV viewing is the most common sedentary activity that children engage in. Although the causal relationship between TV and physical inactivity to obesity is not significant, sedentary lifestyle with long-term TV viewing has potential impact on childhood obesity. Therefore, daily TV viewing should be limited in 2 hours. Additionally, both unhealthy eating behaviors accompany TV viewing and the foods ads on TV are found to result in excess energy intake in children, and serve as critical connecting factors between TV viewing and childhood obesity. Family income and educational background of parents are also healthy indicators of children. Furnishing TV sets in bedroom, dining room or kitchen not only increases TV viewing but also worsens dietary habit. Therefore, increasing physical activity, controlling TV viewing time, carefully selecting TV programs and building healthy environment are effective strategies to prevent childhood obesity.

**KEYWORDS:** Television viewing; Sedentary activity; Dietary habits; Socioeconomic status.

## INTRODUCTION

Since 1980s, Taiwan and many countries were facing the problem of growing prevalence of obesity in children.[1] Yoon et al[2] conducted an obesity epidemic survey of Asian countries, and found that obesity in children has reached epidemic levels. World Health Organization (WHO)[3] has repeatedly warned that the problems of overweight and obesity become more and more severe, and it's almost a global epidemic.

According to the definition of overweight and obesity from International Obesity Task Force (IOTF), the prevalence of obesity among school children aged 6-18 in Taiwan has increased significantly. The prevalence of overweight or obesity in male students rose from 19.6% to 25.3%, while rose from 13.8% to 18.4% in female students.[4] Taiwan Ministry of Education reported the health status of students aged 6-12, showing the percentage of overweight was 14.9% (male 15.85%, female 14.02%), and obese was 10.3% (male 10.92%, female 9.73%). People who were obese during childhood are likely to be also obese when becoming adults. The chance stands more than 50%, and it's five-fold to people who were normal-weight during childhood.[5] The obesity-induced chronic diseases in adults not only cause countless medical expenses in the nation, but also influence the quality of life in individuals. Therefore, while the prevalence of children obesity has been continuously rising, how to control possible factors becomes an important issue.

The benefits of physical activity have been confirmed in many studies in the past.[6]

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However, the proportion of regular exercisers remains relatively low. If taking physical activity recommendations from Centers for Disease Control and Prevention (CDC) and American College of Sports Medicine (ACSM), that is "five to seven days per week, and more than 30 minutes of moderate physical activity per session", there were only 32% adults meeting the recommendations.[7] According to the survey of Bureau of Health Promotion, Department of Health[8] in Taiwan, there were 57% people claimed engaging in physical activity, with male 58.4% and female 55.5% respectively. However, the percentage of those who meet the criteria of regular exerciser was apparently low as 24.82%.

Physical inactivity might result from low engagement or high dropout. Previous studies had explored many exercise barriers, such as feeling irrelevant to exercise, no necessity for active living, negative perception to exercise, avoiding dangerousness or tiredness, lack of time or facilities, without companions, and so on.[9] On the other hand, high dropout also plays a critical role in physical inactivity. Previous research revealed that more than 50% participants would drop out from exercise program within 6 months.[10,11] Influencing factors includes childhood exercise habit, and psychological, physical, social and situational contexts.[12]

Health beneficence of exercise is well known from previous studies. However, the proportion of regular exercisers in Taiwan remains low. Despite low engagement or high dropout, exercise behavior involves multiple factors from physiological, psychological, and social perspectives. Furthermore, previous studies suggested that exercise habits in adulthood are often established from childhood. In other words, childhood is the critical phase influencing the development of exercise behavior in the future. Hence, the present article attempted to analyze daily lifestyle in Taiwan children, and to explore possible strategies to prevent childhood obesity.

## TAIWAN CHILDREN'S LIFESTYLE

Free time after school or on the weekends contribute major active time in children.[13] Study had shown significant negative relationship between sedentary time after school and physical activity. So, the physical activity conducted after school would determine if physical activity is enough for the whole day. The survey showed that the most common activities children engaged in after school were technological sedentary activities, such as TV viewing, PC games, and video games, and doing homework, while active activities included exercise and playing games.[14,15] In recent years, family structure gradually changed. Under the influence of double income families, single parent families and academic-oriented social context, some children go to various kinds of secondary schools or child care program after school or on weekends. Academic pressure in children is less than junior high school students. However, because elementary students are younger, and some of them only have half-day course, parents from double income or single parent families often worry about their children's safety and homework after school. Many child care programs provide pick-up service so that it's quite popular to send children to child care program after school. A survey in 2005 investigated the sedentary activities and daily behaviors in 3-12 years Taiwan children, and found that 6-11 years children spent time watching TV, using computer, reading and going to cram school for 3.5 hours on weekdays and 6 hours on holidays.[16] In the survey, only cram school and artistic classes were calculated in the "secondary school" category. If time spent in child care program had been also calculated, the total sedentary activity time would increase a lot. Therefore, whether participating in child care program after school causes decrease in active time should be further investigated in the future.

## CHILDREN'S SEDENTARY ACTIVITIES

Children spent most of their time sitting and listening to the lectures in school, going to secondary school after school, and watching TV, reading, and playing video games at home.[14] Chang et al. investigated the sedentary activities in 3-12 year children, and found that the children aged 6-11 year spent their time on TV viewing, computer using, and reading in weekdays for 1.8 hrs, 0.4 hrs, 0.6 hrs, 3.4 hrs; and in weekends for 3.4 hrs, 1.2 hrs, 0.8 hrs, and 0.6 hrs respectively.[16] But it should be noticed that the child care program was excluded from calculation, so the average time spent in secondary school might be underestimated. If average sleeping time per day in weekdays is 8 hours, school aged children spend at least 2/3 time sitting or lying. I indicated that the major lifestyle of 6-11 year Taiwan children tends to be sedentary activities.

Research indicates that children spend more time doing sedentary activities. Take TV viewing, computer using, video games playing, and reading as observed variables, it was found that the body mass index (BMI) of children who spend more time in sedentary activities was higher than their counterpart.[17-19] The most representative sedentary activity is TV viewing.

As to the perspective of TV viewing, research investigated the dose-response relationship between TV viewing time and children obesity.[20] They found when TV viewing time extended one more hour, the prevalence of obesity increased 2%. Whether TV viewing substitutes other active activities and results in physical activity decreasing and children obesity is still debatable. Amount of TV viewing and physical activity related to obesity and metabolic risks respectively, while there was no significant correlation between TV viewing and physical activity.[17] Scientists reviewed previous studies, and found TV viewing gradually occupied time of active activities.[21] As to recommendation in TV viewing, research suggested 2 hours as an indicator to predict unhealthy dietary habit and physical inactivity. Because the time spent on TV view would overlap the time spent on physical activity, "Healthy People 2010" set the physical activity goal of children and adolescents as "more than 75% children and adolescents watch TV less than 2 hours in a day". While in the survey conducted in Taiwan in 2001 and 2005, there were 20-30% children who watched TV more than

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2 hours in a day, and the percentage increased to 60-70% on holidays. According to the recommendations in the USA, 20-30% children in Taiwan were classified as low physical activity level, and the percentage almost corresponded to children obesity prevalence. Hence, TV view seems to be an independent indicator to predict children obesity.[22]

As to the perspective of computer using and video game playing, the risk of being overweight increases as the time spent on computer using extends. Research indicated that TV viewing and video games are risk factors of overweight and obesity in 7-11 year school-aged children.[18] There's a significant linear relationship between the time of video games playing and BMI. Children with higher BMI spent general time playing video games, while children with lower BMI spent more or less time playing video games.[19] It was suggested that if children play video games longer, the healthy dietary behavior might be influenced, and then resulted in lower BMI.

## CHILDREN'S DIETARY HABITS

Over the past 30 years, the prevalence of children obesity continuously increases. Research suggested it may be due to the westernization of dietary habit.[23] National Health Interview Survey in 2001 reported that 50% children snacked more than twice, 70% children consumed soft drinks more than once, and 30% children ate fast food more than once per week. In 2009, Taiwan Cancer Foundation conducted a survey of "eating habits of two generations". Results indicated that when children decided what to eat outside, the sequence of their choice was instant noodles (>80%), fried salty chicken, and soya-mixed meat. It meant children preferred high-calorie and heavy tasty foods.

Because the concept of "healthy school" had been advocated in recent years, grocery stores on campus were prohibited to sell high-calorie or high-sugar foods and beverages. In order to prevent children from eating high-calorie foods during recesses, some primary school even terminated the food contract with grocery store on campus. However, beverage chain stores, convenient stores, and vendors surrounding campus are so convenient that children can get foods or drinks quite easily after school or cram school. Excess energy intake possibly results from doing sedentary activities and drinking or eating at the same time. Ekelund et al suggested that high-calorie dietary behavior during inactive period might link the relationship between sedentary activity and obesity.[17] Therefore, further investigation is needed to examine if dietary behavior accompanying sedentary activity after school increases the prevalence of Taiwan children obesity.

TV viewing not only prevents children from doing activities, but also encourages children consume too much high-fat and high-calorie foods while watching TV.[22] Excess energy intake might be the major reason causing children gain weight. Wiecha et al found that each additional hour of television viewing would increase energy intake by 167 kcal per day.[24] A study explored 9-10 year children's self-report of TV viewing behavior, and found that the frequency of watching accompanying eating is positively related to obesity. In other words, TV viewing accompanying unhealthy dietary habits might be the linking factor between TV viewing and children obesity.[17]

Research indicated that the dietary style during TV viewing tends to be high-calorie and high-carbohydrate foods. Matheson et al claimed that although the amount of food consumed during TV viewing was not significantly correlated to BMI.[25] However, 3rd graders consumed more high-calorie foods and fewer vegetables than 5th graders so that there was a significant different relationship between the two groups. So, dietary education in lower-grade elementary students should be more addressed when promoting the concept of healthy diet. Mattes indicated that the increases of TV viewing time indirectly increase the opportunity of drinking sugar-sweetened beverages in children.[26] Because sugar-sweetened drinks contain more obesigenic genes, drinking sugar-sweetened beverages while watching TV might be the linking factor between TV viewing and children obesity.

Besides, children are under great exposure of unhealthy dietary information from TV programs or ads.[21] This information would influence the choice of foods. Major proportion of food ads during the most popular sessions were sugar-sweetened beverages and fast foods.[27] Research showed that food ads not only evoke children's purchasing desire, but also enhance children's drive to ask parents on buying.[28] In addition, research also proved that 9-11 year children ate more snacks after watching food-related ads than non food-related ads.[29]

## FAMILY SOCIOECONOMIC STATUS

Due to economic and scientific development, many families own more than one TV set. According to the survey, almost every family has four TV sets in average. Specifically, 63% children's rooms furnished TV set, while 46% kitchen or dining rooms furnished TV set.[30] Furnishing TV sets in rooms would enhance the convenience of TV viewing. So, research found that children having TV set in their rooms watched more TV for 4.8 hours per week than their counterpart, and the relative odd rates of overweight was 1.31. Therefore, whether furnishing TV in room is a strong predictive indicator of children overweight or obesity.[31] If TV set is furnished in kitchen or dining rooms, the chance of consuming nutritional and vegetables filled with fibers was low. Because when children ate meals and watched TV at the same time, their food choices would tend to be pizza, snacks, or soft drinks.[32] In short, furnishing TV set in room, dining room or kitchen not only increases TV viewing, but also creates an unfavorable environment for balanced nutrition intake.

Family income and educational background of parents represent the capacity that family can afford for the cost of children's expense and providing healthy living environ-

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ment. Therefore, family income and educational background of parents serve as family-socioeconomic indicator to assess children's health.[33-35] Research indicated that the time spent on TV viewing and video games of the children in lower parental educational background families were much more than their counterpart.[35,36] It implied that families with higher income or higher educational background of parents were supposed to provide better health management strategies for their children.

## CONCLUSION

Children obesity is the product of the interaction between genetic and environmental factors. Genetic factors determine the susceptibility of gaining weight on the individuals. Because genetic factors could not be changed considerably great in few decades, the fact that the prevalence of children obesity increased rapidly in the past 30 years revealed the significance of environmental factors. Environmental changes made children fail to strike the balance between energy intake and expenditure, so it provided a condition for increasing the prevalence of obesity. Because of advances in technology, TV, computers and video games become popular in daily life, and increases children's sedentary time. Besides, dietary style has been westernized, and become more delicate, so that high-sugar and high-calorie foods, such as cake, hamburger, French fries, milk tea, coke, and so on replaced traditional foods. Sedentary activities increases, physical inactivity, and unhealthy dietary behavior are all reasons induce children obesity. As long as these negative behaviors are modified, the prevention of children obesity can be enhanced.

**CONFLICTS OF INTEREST:** None.

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OBESITY RESEARCH

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Short Communication

*Corresponding author
**Renee J. Rogers, PhD**
Department of Health and Physical Activity
Physical Activity and Weight Management Research Center
University of Pittsburgh
32 Oak Hill Court
Pittsburgh, PA 15261, USA
**Tel.** 412-383-4015
**Fax:** 412-383-4045
**E-mail:** r.j.rogers@pitt.edu

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# Examination of the Estimated Resting Metabolic Equivalent (MET) in Overweight and Obesity

**Renee J. Rogers, PhD*; John M. Jakicic, PhD**

*Department of Health and Physical Activity, Physical Activity and Weight Management Research Center, University of Pittsburgh, Pittsburgh, PA, USA*

## ABSTRACT

**Background:** Energy expenditure is commonly expressed in multiples of the resting metabolic equivalent task (MET), with 1 MET estimated to be equivalent to 3.5 ml/kg/min or 0.250 L/min of oxygen consumption. This investigation examined whether the estimated resting oxygen consumption used to express a MET was significantly different than measured resting oxygen consumption in overweight, obese class I, and obese class II subjects.
**Methods:** Forty-five (age: 37.5±10.5, BMI: 32.4±3.5) overweight (N=11), Class I (N=21), or Class II (N=13) obese subjects participated in this study. Resting energy expenditure (REE) was assessed on two separate days. Following a 30-minute supine resting period in a semi-darkened room, REE was assessed using the dilution technique. Data were expressed as relative (ml/kg/min) and absolute (L/min) oxygen consumption.
**Results:** Relative oxygen consumption (3.0±0.6 ml/kg/min, $p<0.001$) was significantly lower than the reference value for 1 MET (3.5 ml/kg/min), with no difference across BMI categories, but a difference by gender ($p=0.002$). The reference-MET value over-estimated oxygen consumption for females and under-estimated oxygen consumption for males. There was no difference in the measured absolute resting oxygen consumption compared to the reference of 0.250 L/min; however, there were independent gender ($p<0.001$) and BMI ($p<0.001$) main effects.
**Conclusions:** These differences between the measured and estimated oxygen consumption representing 1 MET in overweight and obese adults may have implications with regards to energy expenditure and its assumed impact on body weight regulation. Continued efforts are needed to understand factors that influence metabolism and the variability observed between individuals in energy expenditure.

**KEYWORDS:** Metabolic equivalent task; Energy expenditure; Obesity; Overweight.

## INTRODUCTION

The metabolic equivalent task (MET) is a measure of resting oxygen consumption that has the benefit of providing a common descriptor of workload or metabolic intensity.[1] The MET is considered to be a universal measure of expressing energy expenditure as a multiple of the resting or reference level in relation to body weight.[2] Based on work conducted in 1941 that involved heat exchange in a neutral environment under resting conditions, Gagge at el[3] are credited with coining the MET terminology, which most closely mirrors the current use of the MET with regard to energy expenditure.

The resting MET is commonly defined as 3.5 ml/kg/min or 0.250 L/min of oxygen consumption.[4,5] The origins of 3.5 ml/kg/min to represent a resting MET value of 3.5 ml/kg/min has been agreed to have resulted from the resting $VO_2$ data obtained from one 40 year old male subject weighing 70 kg.[6,7] Multiples of a resting MET are commonly used to estimate the energy expenditure and work performed during various activity tasks. Therefore, it is important that the estimate of the resting MET be accurate to minimize the likelihood of under- or over-estimation of energy expenditure. Moreover, given the importance of energy expenditure

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to the treatment of obesity, an understanding of whether the current estimates of a resting MET are accurate in individuals who are overweight or obese may be of clinical and scientific importance.

Therefore, the purpose of this investigation is to examine whether the measured resting oxygen consumption, which is used to define a resting MET, in individuals who are overweight or obese is consistent with the widely used estimation of a resting MET (3.5 ml/kg/min or 0.250 L/min of oxygen consumption). Moreover, this study examined whether this varied by gender (male or female) or by grade of overweight or obesity.

## METHODS

Data were obtained from 45 overweight or obese, sedentary, but otherwise healthy adults (age: 37.2±10.5 years; body mass index [BMI]: 32.4± 3.5 kg/m$^2$). Subjects included 34 females and 11 males, with 11 overweight (25.0 to <30.0 kg/m$^2$), 21 with Class I obesity (30.0 to <35.0 kg/m$^2$), and 13 with Class II obesity (35.0 to <40.0 kg/m$^2$). Descriptive data are presented in Table 1.

Height was measured to the nearest 0.5 inch *via* a wall-mounted stadiometer and weight was measured to the nearest 0.5 pound on a calibrated scale with subjects wearing a cloth medical gown or light-weight clothing. BMI was calculated by dividing weight in kilograms (kg) by height in meters squared (m$^2$).

Resting oxygen consumption ($VO_{2rest}$) was measured with a metabolic cart using the dilution technique. Measurements were obtained between 7:30 AM and 10:30 AM. Pre-test instructions included: fasting for at least 12 hours the night before testing, avoiding consumption of any over-the-counter medications, abstaining from all vigorous physical activity the day before testing, and vehicle transportation to the research center the morning of testing. Study participants were questioned to confirm adherence to these pre-testing instructions upon arrival at the research center. Subjects were placed in a supine position in a semi-darkened room for a period of 30 minutes prior to data collection. Data collection occurred for at least 15 minutes with 5 consecutive minutes representing a steady state condition, defined as the range of energy expenditure across this 5 minutes differing by <150 kcal/d.[8] This is consistent with a technique that defined steady state of resting energy expenditure at a coefficient of variation of no more than 5% for both oxygen consumption and carbon dioxide production.[9] The initial 5 minutes were discarded to allow for the subject to acclimate to the dilution canopy, with the average of a subsequent five consecutive data points meeting the <150 kcal/d difference criteria used to represent $VO_{2rest}$.

Statistical analyses were conducted using IBM SPSS Statistics (release version 21.0.0.0). One-sample t-tests were used to compare relative and absolute measured $VO_{2rest}$ to the reference-MET (relative=3.5ml/kg/min, absolute=0.250 L/min) value in all subjects. A multivariate analysis of variance was used to examine the difference measured *versus* estimated $VO_{2rest}$ between genders (males *versus* females) and BMI categories (overweight, Class I obesity, Class II obesity). Main effects were further examined using post-hoc analysis with Bonferroni adjustment.

## RESULTS

Measured relative $VO_{2rest}$ was significantly less than the reference-MET value (3.0±0.6 ml/kg/min *versus* 3.5 ml/kg/min; $p<0.001$). There was no significant Gender X BMI interaction. There was also no significant main effect by BMI category for difference between measured and the reference-MET value for relative $VO_{2rest}$ (Table 2). However, there was a significant difference ($p=0.002$) between males and females for the difference between measured and the reference-MET value for relative $VO_{2rest}$ (Table 2). The reference-MET value over-estimated $VO_{2rest}$ for females by 0.7±0.5 ml/kg/min and under-estimated $VO_{2rest}$ for males by 0.2±0.4 ml/kg/min.

Overall, measured absolute $VO_{2rest}$ (0.275±0.083 L/min) did not differ from reference-MET value (0.250 L/min) (Table 2). While there was no significant Gender X BMI interaction, there was a significant main effect for both Gender ($p<0.001$) and BMI category ($p<0.001$). The reference-MET over-estimated by 0.008±0.59 for females while it under-estimated $VO_{2rest}$ by 0.125±0.066 L/min for males. The difference between the

| Variable | Weight (kg) | BMI (kg/m$^2$) | Age (years) |
|---|---|---|---|
| All Subjects (n=45) | 91.0±13.6 | 32.4±3.5 | 37.2±10.5 |
| Females (n=34) | 87.3±12.0 | 32.7±3.8 | 35.6±11.1 |
| Males (n=11) | 102.5±11.7 | 31.5±2.1 | 42.2±6.5 |
| Overweight (N=11) (BMI=25.0-29.9 kg/m$^2$) | 77.0±11.7 | 28.2±1.5 | 36.4±11.8 |
| Obese Class I (N=21) (BMI=30.0-34.9 kg/m$^2$) | 93.2±10.4 | 32.0±1.3 | 40.6±9.1 |
| Obese Class 2 (N=13) (BMI=35.0-39.9 kg/m$^2$) | 99.3±10.8 | 36.7±1.6 | 32.5±10.1 |

**Table 1:** Demographic characteristics of subjects.

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| | | Body Mass Index Category | | | *p*-value for difference between measured and reference-MET | | |
|---|---|---|---|---|---|---|---|
| Gender | Variable | Overweight (25 to <30 kg/m²) | Obese I (30 to <35 kg/m²) | Obese II (35 to <40 kg/m²) | Gender | BMI Category | Gender X BMI Category |
| Relative $VO_{2rest}$ | | | | | | | |
| Female | N | 8 | 14 | 12 | 0.002 | 0.742 | 0.668 |
| | Measured | 2.73±0.59 | 2.73±0.56 | 2.86±0.54 | | | |
| | Difference* | 0.77±0.59 | 0.77±0.56 | 0.64±0.54 | | | |
| Male | N | 3 | 7 | 1 | | | |
| | Measured | 3.43±0.23 | 3.77±0.47 | 3.51±n/a | | | |
| | Difference* | 0.07±0.23 | -0.27±0.47 | -0.01± n/a | | | |
| Absolute $VO_{2rest}$ | | | | | | | |
| Female | N | 8 | 14 | 12 | <0.001 | 0.006 | 0.697 |
| | Measured | 0.197±0.053 | 0.239±0.049 | 0.277±0.053 | | | |
| | Difference** | 0.054±0.053 | 0.011±0.049 | 0.027±0.053 | | | |
| Male | N | 3 | 7 | 1 | | | |
| | Measured | 0.315±0.034 | 0.393±0.064 | 0.435±n/a | | | |
| | Difference** | 0.065±0.034 | 0.143±0.064 | 0.185±n/a | | | |

*relative reference-MET=3.5 ml/kg/min; positive value indicates reference-MET over-estimated, negative value indicated reference-MET under-estimates
**absolute reference-MET=0.250 L/min; positive value indicates reference-MET over-estimated, negative value indicated reference-MET under-estimates

**Table 2:** Comparison of relative and absolute $VO_{2rest}$ to reference-MET values (mean±standard deviation).

measured and reference-MET value for absolute $VO_{2rest}$ was significantly less in the overweight category compared to both the Class I ($p$=0.010) and Class II ($p$=0.026) obesity categories.

## CONCLUSIONS

This study examined if measured $VO_{2rest}$ differed from widely accepted reference-MET values (3.5ml/kg/min, 0.250 L/min) in adults who are overweight or obese. This study found that measured $VO_{2rest}$ (3.0±0.6 ml/kg/min) in a sample of adults who are overweight or obese is less than the typically used reference-MET value of 3.5 ml/kg/min (Table 2). Results from this study are similar to results from others in which measured $VO_{2rest}$ was less than the reference-MET value of 3.5 ml/kg/min. For example, in a sample of 36 males (age=40.0±3.3 years; BMI=25.9±3.8 kg/m²) measured relative $VO_{2rest}$ (3.0±0.3 ml/kg/min) was significantly lower than the reference-MET value (3.5 ml/kg/min).[10] Gunn et al[11] have also reported a similar pattern in a sample of 50 males (age=60.6±3.2 years; BMI=26.7±3.2 kg/m²). In a mixed sample of males and females, Byrne et al[12] also reported that $VO_{2rest}$ (2.6±0.4 ml/kg/min) was significantly lower than the reference-MET value (3.5 ml/kg/min). However, Byrne et al[12] did not examine whether there was a gender influence on the difference between the measured and reference-MET value. By comparison, the current study did report a gender difference between the measured and reference-MET value, with reference-MET value over-estimating $VO_{2rest}$ for females and under-estimating $VO_{2rest}$ for males.

Another unique contribution of the current study is the examination of whether the difference between measured and the reference-MET value was influence by BMI. Results showed no difference across BMI categories when examining relative $VO_{2rest}$; however, the difference between measured and the reference-MET value for absolute $VO_{2rest}$ (L/min) was less in the overweight category compared to the Class I and Class II obesity categories. This may suggest that at higher levels of BMI the reference-MET for absolute $VO_{2rest}$ (0.250 L/min) has less utility as an accurate measure. Others studies that have directly compared the measured and reference-MET value for $VO_{2rest}$ have not examined the potential influence of BMI. This finding also has implications when using the reference-MET value of 0.250 L/min to estimate the energy costs of physical activity, as this may over-estimate the energy cost more as BMI increases.

Currently, $VO_{2rest}$ is used to represent the resting MET, and multiples of this resting value are universally used to express energy expenditure of various forms of physical activity.[1,2] The origins of the MET to express energy expenditure during different forms of physical activity relative to resting energy expenditure appears to date back to approximately 1890,[13] which was followed by similar observations made decades later.[3,14] Thus, the findings of the current study, which are similar to the finding of others,[10,12] may suggest that the energy cost of a variety of physical activities may be over-estimated when using common reference-MET values. Moreover, the data from this study may suggest that this over-estimation may be of particular concern for women and for individuals at a higher BMI. However, given the relatively small sample and the limited inclusion criteria, these findings should be interpreted with caution and warrant further replication.

In summary, this study demonstrated that the conventional estimates of $VO_{2rest}$, represented as the MET, may differ

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from measured values in adults who are overweight or obese. These findings may have implications on estimates of resting and physical activity energy expenditure. Thus, while additional research to confirm these findings is warranted, this may suggest the need to establish new estimates of the resting MET that can be used broadly in clinical applications aimed at prevention or treatment of obesity.

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**CONFLICTS OF INTEREST**

The authors declared conflicts of interest.

**AUTHOR CONTRIBUTIONS**

RJR: Manuscript development; Statistical analyses.
JMJ: Data collection; Statistical analyses; Manuscript revision.

**CONSENT STATEMENT**

As per University of Pittsburgh Instructional Review Board Guidelines, all original signed consent forms have been retained by the principal investigator.

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Research

*Corresponding author
**Farouk El-Sabban, PhD**
Professor of Nutrition and Physiology
Department of Food Science and Nutrition
College of Life Sciences
Kuwait University
P.O. Box 5969, Safat 13060
Kuwait City, Kuwait
**Tel.** +965-2463-3081
**Fax:** +965-2251-3929
**E-mail:** farouk.elsabban@.ku.edu.kw

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# Perception of Body Weight Gain among First-Year Kuwait University Students

**Farouk El-Sabban, PhD*; Hameda Al-Feeli, BSc; Kawthar Shehab, BSc**

*Department of Food Science and Nutrition, College of Life Sciences, Kuwait University, P.O. Box 5969, Safat 13060, Kuwait City, Kuwait*

## ABSTRACT

This work was carried out to study the perception of 440 female and male first-year Kuwait University students on body weight gain. Students attended 11 colleges of the University, 6 of theoretical-type and 5 science-type colleges. Each college was represented by 40 students of both genders. Freshmen were chosen for this study to reduce the influence of their subsequent studying at different colleges to a minimum. A simple questionnaire that contained a section on demographics and 5 subsections, with 2 statements for each, was utilized in collecting responses from willing students. Correct responses were agreed upon by a panel of nutritionists and trained interviewers administered the questionnaire on a face-to-face basis. Obtained results were recorded and were statistically analyzed, with a set level of $p<0.05$ for statistical significance. Results showed varied percentages in the numbers of correct answers for 2-4 subsection (14-21%) and that only 5% of students answered all correctly. Demographic factors that significantly influenced responses were: college type on subsection 4($p<0.001$), governorate of residence on subsection 3($p<0.01$), and number of siblings on subsection 2($p<0.05$). Other demographic factors: age, gender nationality father education, mother education and monthly income did not influence responses. With concerns being raised in the literature about the nutrition and lifestyle of university students and, consequently their effect on body weight change, it is recommended that a short course on basics of healthy nutrition and lifestyle should be offered to freshmen across all study disciplines taught in universities. Educational interventions could prove valuable for their stage of study and for the rest of their lives.

**KEYWORDS:** Attitude; Health; Knowledge; Nutrition; Students; University.

**ABBREVIATIONS:** SPSS: Statistical Package for Social Studies; ANOVA: Analysis of variance; GCC: Gulf Cooperation Council; WHO: World Health Organization; BMI: Body Mass Index; YRBSS: Youth Risk Behavior Surveillance Survey.

## INTRODUCTION

Normal body weight is one of the desired parameter for enjoying good health. It can be attained and maintained by following a healthy lifestyle that involves following sound nutrition and being engaged in a regular physical activity program. Excess body weight is mainly because of storage of fat and this heavier weight is a risk factor for some diseases such as diabetes, hypertension and other cardiovascular diseases – among many others. The status of body weight of an individual is a reflection of the overall effects of influencing factors, such as genetics, environment and nutritional status – among others that can be cultural.

University students constitute a segment of the population in any society. They are young and able to acquire knowledge. Promoting a healthy pattern for their nutrition and physical activity would be beneficial to them, their peers and members of their immediate family circle and those whom they may relate to and interact with. First-year university students are those who have just come out of high school with different scholarly interests – thus, they may choose to join either a theoretical-type or scientific-type colleges accordingly. Students in their

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first year at the university may still carry over their active life from their high school years; then as they progress in their studies and with mounting academic pressure, their lifestyle would be modified. Freshmen scored higher in health-promoting lifestyle profile than when they were in subsequent study years.[1] University students were found to be at risk of eating disorders and can be vulnerable to disturbance in their body weight and its perception.[2] About 15% of Spanish university students suffered from disturbed eating attitudes and 73% led an inactive lifestyle.[3] American freshmen gained between 1.5-3.0 kg of their body weight during the first semester in the university.[4] A meta-analysis of body weight change in first-year students in the United States showed that nearly 66% gained an average of 3.5 kg and 10% of them gained nearly 7 kg.[5]

With regard to university students in Kuwait, a study revealed an alarming finding, which is that nearly 93% of females and males were either overweight or obese.[6] A study that involved 1037 female and male first-year students at Kuwait University detected certain deficiencies in nutritional knowledge; however, 71% felt that their health was good, 66% stated that their nutrition as being healthy, 77% were satisfied with their body weight and 56% followed a certain diet to be satisfied about their weight.[7] The main perceived barriers to weight maintenance among university students in Kuwait were not having the skills to plan, shop for or time to prepare healthy food.[8] With such concerns about university students' attitude and potential changes in their body weight, it was of interest to explore the perception of students on some aspects of body weight gain. Without having freshmen to be influenced by the subject matters they have chosen to study, this work was limited to first-year students at Kuwait University.

## MATERIALS AND METHODS

### The University Setting

Kuwait University is the main national institution of higher learning in Kuwait, with a student body of nearly 36,000. Females account for nearly 2/3 of the total student population of the University. The University has several colleges, some are known as theoretical (such as the colleges of law, business administration, arts…etc.) and the others are those known as scientific (such as colleges of science, engineering and petroleum, life sciences…etc.). Being an urban university, colleges are located at different sites in the country.

### The Questionnaire and Respondents

A simple questionnaire that contained a section on demographics and a section on perceived body weight gain was utilized. The section relating to weight gain consisted of 5 subsections, which were statements to be answered. Each subsection contained an aspect of body weight gain with two different statements, to which students were to check either of the statements, i.e., one answer only (Table 1). A panel of 5 nutritionists agreed on the correct statements of the questionnaire; thus, such were adopted and used for analysis of secured data. Responses were collected from a total of 440 first-year students from eleven colleges of Kuwait University, 40 from each college of the 6 theoretical colleges and the 5 science-oriented colleges. Theoretical-type colleges were those of: Arts, Business Administration, Education, Islamic Studies, Law, and Social Sciences. Science-oriented colleges were those of: Allied Health Sciences, Engineering and Petroleum, Life Sciences, Medicine, and Science. When students declared that they are in their first year of study at the University, they were asked to participate in this study at random. Students who agreed to respond to this survey offered their voluntary consent. Trained personnel were made familiar with the questionnaire first, then they recorded the student answers from those who were willing to participate.

### Statistical Analysis

Data were recorded and analyzed using the IBM Statistical Package for Social Studies (SPSS) Editor, version 20 (International Business Machines Corporation, New York, USA) between February and April 2016. Descriptive analysis were expressed in terms of percentages. The analysis of variance (ANOVA) was utilized to detect the significance of any influencing factors (e.g.; age, gender, college of study…etc.) on student perception of body weight gain. The level of significance for these tests was set at $p<0.05$.

| No. | Subsection statements | Choice answer* |
|---|---|---|
| 1A | Overweight problem is due mainly to genetic and physiological factors | |
| 1B | Overweight problem is due mainly to loss of self-control | Yes |
| 2A | Overweight people can lose weight if they are determined | Yes |
| 2B | Overweight people can lose weight if they have considerable external motivation | |
| 3A | Weight reduction pills are effective in reducing body weight | |
| 3B | Those who lost weight because of pills will re-gain their weigh with time | Yes |
| 4A | Overweight people feel hungry because of their expectation of being hungry | |
| 4B | Overweight people feel hungry because of stomach contraction and low blood sugar level | Yes |
| 5A | Overweight problem is related to early childhood and is resistant to change | |
| 5B | Overweight problem is related to poor dietary habits, which can be simply changed | Yes |

*Agreed upon by a panel of 5 nutritionists.

**Table 1:** Items of the questionnaire on aspects of body weight gain.

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## RESULTS

Respondents to the administered questionnaire were 285(65%) females and 155(35%) males, with an average age of 18.2±0.5 years. The total number of students was 440, of which 240 studied at theoretical colleges and 200 were from scientific colleges. Demographic data of this study population are presented in Table 2. The majority (85%) were Kuwaiti nationals, with the remainder being non-Kuwaitis. Students came from the different governorates of Kuwait. As for the educational level of their fathers, the majority (76%) had university education and higher, with lesser percentages of 16 with diplomas and 8 for up to high school level. In contrast to fathers, nearly 46% of the mothers had a university education or higher – with 31 and 23% who obtained diplomas and had up to high school education, respectively. The majority of students (75%) came from homes with a relatively high monthly income. Most of students had 0-7 siblings (84%) and the remainder had 8 or more siblings.

Computed correct responses for the 5 subsections, based on gender, are shown in Table 3. The overall results showed that about 2% of students did not get answers to any of the statements of subsections correctly. Correct answers for 1 to 3 statements ranged between 14-21%, with 39% answering 4 statements correctly. Only 5% of students answered all 5 subsection statements correctly. Data of further statistical analysis to reveal influencing factors on the answers of the 5 subsections are shown in Table 4. The type of college only influenced subsec-

| Item | Theoretical Colleges | Scientific Colleges | Total |
|---|---|---|---|
| Gender | | | |
| Female | 143 | 142 | 285 |
| Male | 97 | 58 | 155 |
| Age (y) | | | |
| 17-18 | 186 | 146 | 332 |
| 19-20 | 54 | 54 | 108 |
| Nationality | | | |
| Kuwaiti | 198 | 176 | 374 |
| Non-Kuwaiti | 42 | 24 | 66 |
| Governorate of residence | | | |
| Al-Asima | 33 | 60 | 93 |
| Al-Ahmadi | 12 | 19 | 31 |
| Hawalli | 74 | 68 | 142 |
| Al-Jahraa | 40 | 4 | 44 |
| Al-Farawania | 52 | 27 | 79 |
| Mubarak Al-Kabir | 29 | 22 | 51 |
| Father education | | | |
| Up to high school | 7 | 26 | 33 |
| Diploma | 52 | 20 | 72 |
| >University | 171 | 154 | 335 |
| Mother education | | | |
| Up to high school | 77 | 25 | 102 |
| Diploma | 68 | 67 | 135 |
| >University | 95 | 108 | 203 |
| Monthly income (KD) | | | |
| 500-1000 | 7 | 19 | 26 |
| 1000-1500 | 27 | 58 | 85 |
| 1500-2000 | 106 | 60 | 166 |
| >2000 | 100 | 63 | 163 |
| No. of siblings | | | |
| 0-3 | 60 | 42 | 102 |
| 4-7 | 127 | 139 | 266 |
| 8-11 | 51 | 19 | 70 |
| >11 | 2 | 0 | 2 |

**Table 2:** Demographic data of the theoretical (n=240) and scientific (n=200) college student population (total n=440).

| Status of Answers | Females No. (%) | Males No. (%) | Total No. (%) |
|---|---|---|---|
| All Wrong Answers | 3(1.1) | 4(2.6) | 7(1.6) |
| One Correct Answer | 53(18.6) | 30(19.4) | 83(18.9) |
| Two Correct Answers | 40(14.0) | 21(13.5) | 61(13.9) |
| Three Correct Answers | 65(22.8) | 29(18.7) | 94(21.4) |
| Four Correct Answers | 108(37.9) | 64(41.3) | 172(39.1) |
| All Correct Answers | 16(5.6) | 7(4.5) | 23(5.2) |
| Total Responses | 285 | 155 | 440 |

**Table 3:** Computed correct responses for statements, based on the gender of students.

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| Item | Subsection* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1A | **1B**** | **2A**** | 2B | 3A | **3B**** | 4A | **4B**** | 5A | **5B**** |
| College type | | | | | | | | | | |
| Theoretical | 87 | **153** | **81** | 159 | 73 | **167** | 90 | **150** | 75 | **165** |
| Scientific | 84 | **116** | **84** | 116 | 53 | **147** | 112 | **88** | 61 | **139** |
| ***p* value** | 0.219 | | 0.075 | | 0.367 | | 0.001 | | 0.866 | |
| Gender | | | | | | | | | | |
| Female | 112 | **173** | **107** | 178 | 82 | **203** | 128 | **157** | 85 | **200** |
| Male | 59 | **96** | **58** | 97 | 44 | **111** | 74 | **81** | 51 | **104** |
| ***p* value** | 0.800 | | 0.980 | | 0.932 | | 0.570 | | 0.506 | |
| Age | | | | | | | | | | |
| 17-18 | 137 | **194** | **121** | 210 | 99 | **232** | 152 | **179** | 100 | **231** |
| 19-20 | 34 | **75** | **44** | 65 | 27 | **82** | 50 | **59** | 36 | **73** |
| ***p* value** | 0.241 | | 0.145 | | 0.339 | | 0.908 | | 0.436 | |
| Nationality | | | | | | | | | | |
| Kuwaiti | 151 | **223** | **148** | 226 | 107 | **267** | 173 | **201** | 116 | **258** |
| Non-Kuwaiti | 20 | **46** | **17** | 49 | 19 | **47** | 29 | **37** | 20 | **46** |
| ***p* value** | 0.365 | | 0.065 | | 0.409 | | 0.541 | | 0.827 | |
| Governorate | | | | | | | | | | |
| Al-Asima | 36 | **57** | **38** | 55 | 26 | **67** | 43 | **50** | 27 | **66** |
| Al-Ahmadi | 9 | **22** | **8** | 23 | 5 | **26** | 16 | **15** | 7 | **24** |
| Hawalli | 56 | **86** | **49** | 93 | 43 | **99** | 71 | **71** | 49 | **93** |
| Al-Jahraa | 16 | **28** | **16** | 28 | 10 | **34** | 18 | **26** | 14 | **30** |
| Al-Farawania | 37 | **42** | **34** | 45 | 28 | **51** | 32 | **47** | 26 | **53** |
| M. Al-Kabir | 17 | **34** | **20** | 31 | 14 | **37** | 22 | **29** | 13 | **38** |
| ***p* value** | 0.529 | | 0.545 | | 0.014 | | 0.839 | | 0.634 | |
| Father education | | | | | | | | | | |
| ≤ High school | 9 | **24** | **14** | 19 | 1 | **32** | 18 | **15** | 7 | **26** |
| Diploma | 26 | **46** | **30** | 42 | 19 | **53** | 32 | **40** | 25 | **47** |
| >University | 136 | **199** | **121** | 214 | 106 | **229** | 152 | **183** | 104 | **231** |
| ***p* value** | 0.244 | | 0.564 | | 0.399 | | 0.719 | | 0.720 | |
| Mother education | | | | | | | | | | |
| ≤High school | 39 | **63** | **37** | 65 | 21 | **81** | 39 | **63** | 23 | **79** |
| Diploma | 52 | **83** | **53** | 82 | 41 | **94** | 59 | **76** | 42 | **93** |
| >University | 80 | **123** | **75** | 128 | 64 | **139** | 104 | **99** | 71 | **132** |
| ***p* value** | 0.337 | | 0.731 | | 0.089 | | 0.100 | | 0.807 | |
| Mon. income (KD) | | | | | | | | | | |
| 500-1000 | 13 | **13** | **11** | 15 | 1 | **25** | 13 | **13** | 8 | **18** |
| 1000-1500 | 28 | **57** | **37** | 48 | 21 | **64** | 50 | **35** | 25 | **60** |
| 1500-2000 | 67 | **99** | **61** | 105 | 52 | **114** | 69 | **97** | 57 | **109** |
| >2000 | 78 | **100** | **56** | 107 | 52 | **111** | 70 | **93** | 46 | **117** |
| ***p* value** | 0.674 | | 0.731 | | 0.089 | | 0.100 | | 0.807 | |
| No. of siblings | | | | | | | | | | |
| 0-3 | 34 | **68** | **28** | 74 | 20 | **82** | 45 | **57** | 26 | **76** |
| 4-7 | 104 | **162** | **102** | 164 | 79 | **187** | 125 | **141** | 92 | **174** |
| 8-11 | 32 | **38** | **23** | 37 | 26 | **44** | 31 | **39** | 17 | **53** |
| >11 | 1 | **1** | **2** | 0 | 1 | **1** | 1 | **1** | 1 | **1** |
| ***p* value** | 0.883 | | 0.510 | | 0.157 | | 0.046 | | 0.307 | |

*Total number of responses to both A and B for each subsection is 440.
**Numbers in bold in columns are those of correct answers.

**Table 4:** Student responses to statements and results of influencing factors based on ANOVA.

tion 4($p<0.001$), the governorate of residence influenced subsection 3($p<0.01$), and the number of siblings had an influence on subsection 2($p<0.04$). Other possible influencing factors, such as: gender, age, nationality, education level of father, education level of mother, and monthly family income did not have significant effects on student answers of any of the 5 subsections of the questionnaire.

## DISCUSSION

Since the discovery of oil, Kuwait and the rest of the Gulf Cooperation Council (GCC) countries have gone through a transition towards urbanization. Most of these countries enjoy economic affluence and the comfort of modern life. Food supply is abundant and many of the fast food establishments are wide-spread in this region.[9] Increased food consumption and lack of sufficient level of physical activity among populations of these countries resulted in an alarming high rate of overweight and obesity.[10] Overweight and obesity are considered as a risk factor for many chronic diseases, thus they constitute a serious threat to public health. Many of the nutrition-related diseases in this region; such as: diabetes, hypertension,[11] and coronary heart disease[12] are most prevalent. As all segments of the population are subjected to such societal conditions, it would be natural to expect

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that university students are also affected by such circumstances.

The ratio of female to male student enrollment at Kuwait University has been nearly 2:1 since 2009[7] and continues to be about the same. Our study sample was in close accordance with such a ratio; thus, it can be considered as representative. Also, students represented different theoretical-type and science-oriented colleges. First-year students were chosen for this study, so that the influence of their study in subsequent years would be minimized. Demographic parameters chosen were those that were expected to be influential on student perception of body weight gain. Students of this study were: close in age, represented both genders, mostly Kuwaiti nationals, from different locations in the country, mostly with university-educated fathers, educated mothers, majority from on the "well-to-do" families, and mostly with up to 7 siblings.

Computed correct responses to the contents of the 5 subsection of the administered questionnaire were generally low, with only 5% of students answering all 5 correctly. This was not a surprise, as such could be related to the reported fair level score of nutrition knowledge and a low level of awareness about the relationship between nutrition and disease among first-year Kuwait University.[7] Further analysis of the data revealed that most demographic factors did not prominently influence student perception on aspects of body weight gain, with the exception of a few. This could be a function of the personality development attained during the transition from high school to the university environment, in spite of that most Kuwait University students live at their family homes and commute between them daily. However, it was expected that students of science-oriented colleges would have higher percentages of correct answers than their counterparts at the theoretical-type.

Dimensions of the issue at hand has to do with the global, including the Eastern Mediterranean Region[13] problem of overweight and obesity, nutritional habits, individual lifestyle, level of nutrition education, and individual perception of body weight and shape. The World Health Organization (WHO) of the United Nations considers that body weight gain as one of the leading global health problems and recommended that promotion of weight loss as one strategy to fight this global overweight and obesity epidemic.[14,15] However, most people who lose weight through lifestyle modifications tend to regain the weight within several years.[16] Thus, there seems to be a need for more proactive and effective strategies to combat this danger. Overweight and obesity represent a threat to public health for all segments of society in Kuwait, including: children,[17] adolescents,[10,18] adults,[19] and the elderly.[20]

What became known as the "freshman 15" was coined in the United States to indicate that students attending their first year of university or college gain about 15 lb (6.8 kg).[21,22] This was found to be significantly more weight than age-matched individuals who did not attend university or college.[23] Students gained approximately 6 kg after four years of college and overweight and obesity increased from 18 to 31% by the end of a study.[24] In the United States, most students move to the university campus – where they typically have "all-you-can-eat" meal plans and lack of parental supervision.[25] Also, during the freshman time period at a university or college, many social forces act on students to change their feeding, drinking, and sporting behaviors.[26] Many students who were active in sports in high school, either stopped being active or were less active when they joined the university.[24] Thus, the freshman period at university or college has been identified as a period of high risk for weight gain.

This university student body weight gain phenomenon was also studied in Europe. In Belgium, 68% of students in their first semester at the university gained an average of 1.0 kg in weight and 66 showed an increase in body mass index (BMI).[27] In The Netherlands, students gained an average of 1.1 kg in weight in first 3 months in the university and the weight gain continued throughout the 4 years of their education, with averages of 6 kg for males and nearly 2 kg for females. Students with weight gain experienced hindrance in exercise and mental well-being. Only those students who did not have irregular eating habits wanted to change their lifestyle.[28] In Spain, female and male students were found to lead a sedentary lifestyle in their first year at the university and as the academic year progressed, dietary habits deviated much from the healthy Mediterranean-type diet.[29] Thus, it was concluded that university students represent a social group that is at risk of having inappropriate nutritional habits and lifestyle.

Misperception of self-reported body weight and shape among university students and other humans seems to be universal across the globe. This misperception represents a difficulty in view of accurate data collection and in mapping appropriate strategies for curbing the obesity problem. In the United States, 48% of university students who were overweight and 23% of those who were obese perceived themselves as being in the healthy weight category. Students overestimated their healthy weight status, while underestimating their overweight status.[30] Overweight and obese individuals who misperceived their weight status were less likely to want to lose weight or have tried to lose weight, as compared to overweight and obese individuals who perceived their weight accurately. Females and males who misperceived their weight were also less likely to be engaged in more physical activity.[31] A nationally representative sample of 50,240 students of 9-12 grade students in both public and private schools - the Youth Risk Behavior Surveillance Survey (YRBSS) that took place between 2001-2009, showed that adolescents who perceived themselves as overweight had a stronger intention to lose weight. However, they did not develop better eating or exercise habits. In contrast, normal-weight adolescents, if they perceived themselves as overweight – were more likely to engage in health-compromising weight loss methods. It was concluded that it is critical to transform weight loss intentions to actual behaviors, in addition to having behavioral interventions to combat childhood obesity.[32]

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A study across 7 European countries showed that between 32-68% of student populations were satisfied about their body weight, while large proportions were dissatisfied and were trying to lose weight. Their perceived weight did not always reflect actual weight status based on the BMI. Females, in particular, perceived themselves as being overweight, despite low rates of obesity among them.[33] Perception of body image by Italian university students showed that greater dissatisfaction and higher weight status perception consistency in females than in males among those examined.[34] Studies of body weight perception among university students were conducted in the Far East. In Korea, height, weight, and the distribution of obesity index showed significant differences between female and male college students. Also, differences were found between genders about self-perception of body image and in the necessity for body weight control.[35] Percentages of 29 and 26% of both female and male Korean adolescents misperceived their body weight status, respectively. Within each misperception, overestimation was higher than underestimation. Weight misperception was found to be associated with socio-demographic factors such as gender, age, BMI, place of residence, and maternal education level.[36] Eating behavior, perception of body shape, and physical status among Japanese university students were studied. Restrained, emotional, and external eating habits were higher in the females than in the males and ideal body shape was lower than its perception among females. It was concluded that gender differences regarding ideal body shape were related to eating behavior.[37] Prevalence of overweight and obesity among Japanese and Korean female university students was low. Body shape perception and ideal body shape were strongly influenced by socioeconomic factors.[38] In Thailand, both female and male university students significantly under-reported their weights and over-reported their heights, which showed discrepancies between perceived and measured (true) data.[39]

Collectively, studies have shown that misperceptions of body weight, height, BMI, and body shape of university students are subjected to a variety of influencing factors. Such factors include: gender,[35,36] age,[36] place of residence,[36] maternal education level,[36] eating behavior,[37] and socioeconomic factors.[38] Aspects of body weight, height, BMI, and body shape are all related to nutrition and lifestyle. Since university students viewed as a group that is at risk of having inappropriate nutritional habits and lifestyle,[29] enhancing their self-awareness of these aspects and about their related health risks would be of an empirical importance. Such can be achieved by interventional programs that raise the level of nutrition knowledge of adolescents and of their parents.[36] Also, it is critical to transform weight loss intentions to actual behaviors to combat childhood obesity.[32] It was recommended that a short course on nutrition and nutrition-related diseases to be conducted across all study disciplines at Kuwait University.[7] As results of this study showed low percentages of correct answers to the subsections of the administered questionnaire, the previous recommendation for such an educational course is hereby repeated. Also, since the internet is widely-available and that university students are among the avid users of computers, devised and implemented online awareness programs can prove to be as valuable tools. A study demonstrated the feasibility of an inexpensive internet-based intervention in preventing weight gain among college students in the first semester of college.[40] Other innovative means of electronic media communication that can be interactive in nature may prove to be beneficial to university students

## CONCLUSION

This work was conducted to study the perception of first-year Kuwait University students at 11 colleges, 6 of the theoretical-type and 5 of the science-oriented type. Females represented 65% and males represented 35% of a total of 440 students, who voluntarily responded to an administered questionnaire. Data of correct answers to questionnaire subsections on body weight gain were poor to fair, thus indicating a deficit in relevant knowledge. These results necessitate the need to enhance many aspects of nutrition and lifestyle. It is recommended that a short course on nutrition and the risks for disease that result from inadequate or improper nutrition ought to be offered to first-year students across all disciplines being studies at the university. Development of online, and/or other computer-oriented, programs for enhancing students' awareness and knowledge can be devised and implemented. Such programs that are interactive in nature could prove advantageous, as the internet is widely-available and nowadays university students are avid users of it. This approach can be considered as an inexpensive means of nutritional intervention and should be tried alongside all other means of education and intervention.

## CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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