RELATIONSHIP BETWEEN DIETARY PATTERNS WITH BODY MASS INDEX, WAIST CIRCUMFERENCE AND BLOOD PRESSURE AMONG SECONDARY SCHOOL CHILDREN IN MASHHAD, IRAN

KHOSRO SHAFAGHI

FPSK(p) 2015 27

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By

KHOSRO SHAFAGHI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirement for the Degree of Doctor of Philosophy

November 2015

DEDICATION

This thesis is dedicated to

MY KIND MOTHER

MY DEAR WIFE

and

MY DEAR SON

for

THEIR ENDLESS PATIENCE AND LOVE

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

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Chairman: Pro. Madya Zalilah Bint Mohd Shariff, PhD

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Obesity is a public health concern across developed and developing countries. In Iran, cardiovascular diseases are leading cause of death, while obesity and blood pressure, both are related to them. However, there is a lack of study on the relationship between dietary patterns, obesity and blood pressure among adolescents in Iran. The purpose of this study was to identify major dietary patterns of adolescents and to examine the relationship between dietary patterns with body mass index (BMI), waist circumference (WC), and blood pressure (BP) among secondary school children (12-14 years) in Mashhad, Iran. Dietary intake is an important determinant of obesity and blood pressure. The dietary pattern approach considers the overall diet of person by taking into account intake of combined food and nutrition.

This cross-sectional study of 1189 secondary school children (579 males and 610 females) aged 12-14 years old were selected through a stratified multistage random sampling, was conducted in urban low and high socio-economic area of Mashhad. Dietary intake was assessed by interview using semi-quantitative food frequency questionnaire (FFQ) with 121 items, 24-hour dietary recall, and food record. All adolescents were measured for weight and height, then measurements were used to calculate BMI based on the formula: BMI= Body Weight (kg) / Height (m^2). BMI were categorized using the World Health Organization cut-off points (WHO, 2007). Blood pressure was determined and classified based on cut-off points (NHBP, 2004). The Principal Component Factor analysis was applied to drive dietary patterns. Twenty nine (29) food groups were entered into the factor analysis. Logistic regression analysis was used to calculate odds ratio (OR). An exploratory factor analysis resulted in two types of dietary patterns that accounted for 26.6% of the total variance for the original dietary intake. Healthy dietary pattern was characterized by higher intake of fish and other sea foods, fruits, and fruit juice, green, white and yellow vegetables, whole grains, dried and processed fruits. The Unhealthy dietary pattern was heavily loaded on sweets, sugars and confectionary, tea, and coffee, egg, cooked, and fried potato, and moderately loaded on snacks, nuts, Iranian broth, and pickles.

Household socio-demographic information, lifestyle factors, eating and meal patterns parental BMI and dietary patterns was determined. Parents' weight and height were self-reported by them. All statistical analyses were performed using the Statistical Package for Social Sciences (SPSS 17) for windows. All variables were tested for normality by Kolmogorov-Smirnoff. The level of significance for all statistics was set at $p< 0.05$ levels and all analyses were two-tailed. Descriptive statistics was used to summarize continuous variables using mean, standard deviations and frequencies. Multivariate logistic regression was used to identify the association between independent variables and outcome variables (child's BMI, WC, and BP) while controlling for potentially confounding variables.

The overall prevalence of overweight and obesity among secondary school children in Mashhad was 17.2% and 11.9%, respectively. A higher proportion of male (30.7%) than female (27.4%) children were overweight or obese. BMI of the children was significantly related to gender ($p= 0.02$), birth order ($p<0.01$), parents' education level ($p< 0.001$), father's employment status ($p< 0.001$) and family monthly income ($p< 0.001$). Other variables such as TV watching duration among males ($P=0.002$), eating behaviors, several eating restraint items, dietary patterns ($p< 0.001$), and parental BMI ($p< 0.001$) were significantly associated with BMI. Furthermore, variables like eating restraint, eating behaviors, TV watching in males ($p=0.003$), BMI ($p=0.001$), WC ($p=0.04$), and dietary patterns ($p=0.01$) showed significant association with blood pressure. The high prevalence of overweight and obesity among secondary school children as compared to previous studies in Iran could be related to the changing lifestyle of the population as reflected in the selected socio-demographic factors. The strong relationship to parental BMI was probably related to a combination of genetic and lifestyle factors. Strategies to address childhood obesity should consider the interaction of these factors and its impact on lifestyle behaviors of children and adolescent.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

HUBUNGAN ANTARA POLA DIET DENGAN INDEX JISIM TUBUH, LILITAN PINGGANG DAN TEKANAN DARAH TINGGI DALAM KALANGAN PELAJAR SEKOLAH MENENGAH DI MASHHAD,IRAN

Oleh

KHOSRO SHAFAGHI

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Obesiti merupakan kebimbangan kesihatan awam bagi negara-negara maju dan juga membangun. Di Iran, penyakit kardiovaskular merupakan penyebab utama kematian, manakala obesiti dan tekanan darah tinggi , kedua-duanya saling berkaitan dengannya. Walau bagaimanapun, terdapat kekurangan kajian tentang hubungan antara pola diet, obesiti dan takanan darah tinggi dalam kalangan remaja di Iran. Objektif kajian ini adalah untuk mengenal pasti pola diet utama dalam kalangan remaja dan untuk menentukan hubungan antara pola diet dengan index jisim tubuh (BMI) , lilitan pinggang (WC), dan tekanan darah tinggi (BP) dalam kalangan pelajar sekolah menengah (12-14 tahun) di Mashhad, Iran. Pengambilan diet merupakan determinan penting obesiti dan tekanan darah tinggi. Pendekatan pola diet mempertimbangkan keseluruhan diet seseorang dengan mengambil kira pengambilan makanan tergabung dan nutrisi.

Kajian keratan rentas ini merangkumi 1189 pelajar sekolah menengah, termasuk 579 lelaki dan 610 perempuan, berumur antara 12-14 tahun dipilih melalui persampelan rawak multitahap bersusun lapis, telah dijalankan di kawasan bandar Mashhad. Pengambilan diet telah dinilai melalui temuduga menggunakan soal selidik kekerapan pemakanan separa kuantitatif (FFQ) dengan 121 item, 24 jam ingatan kembali diet, dan rekod pemakanan. Semua remaja diukur bagi mendapatkan berat, ketinggian, tekanan darah tinggi. Analisis Faktor Komponen Prinsipal diaplikasikan untuk memperoleh pola diet. Dua puluh sembilan (29) kumpulan makanan dimasukkan ke dalam analisis faktor. Analisis regresi logistik digunakan untuk mengira nisbah ganjil (OR). Analisis faktor eksploratori menghasilkan dua jenis pola diet yang menjelaskan 26.6% jumlah varians bagi pengambilan diet asal. Pola diet sihat telah dikategorikan melalui pengambilan tinggi ikan dan makanan laut lain, buah-buahan, dan jus buah-buahan, sayuran-sayuran putih dan kuning, bijian sempurna , buah-buahan kering dan awet. Pola diet tidak sihat adalah daripada pengambilan tinggi manisan , gula dan konfektionari, teh dan kopi, telur , kentang masak dan bergoreng, dan secara sederhana makanan daripada snek, kekacang, brot Iran, dan jeruk.

Maklumat sosiodemografi isi rumah, faktor gaya hidup , pola pemakanan dan pola keibubapaan dan pola diet telah dikenal pasti. Ketinggian dan berat ibu bapa dilaporkan sendiri oleh pelajar. Analisis statistikal akan dilaksanakan dengan menggunakan Pakej Statistik untuk Sains Sosial (SPSS 17) bagi Windows. Semua variabel telah diuji bagi mendapatkan normaliti dengan menggunakan Kolmogorov-Smirnoff. Tahap signifikan bagi semua statistik telah disetkan pada $p<0.05$ dan semua analisis merupakan analisis dua hujung.Statistik deskriptif digunakan bagi merumuskan variabel berterusan dengan menggunakan min, standard deviasi dan kekerapan. Regresi logistik multivariat digunakan untuk mengenal pasti hubungan antara variabel independen dan variabel hasil (BMI pelajar, WC, dan BP) di samping mengawal variabel perancu yang berpotensi.

Keseluruhan prevalen bagi pelajar sekolah menengah yang terlebih berat dan obes masing-masing ialah 17.2% dan 11.9%. Perkadaran yang tinggi adalah dalam kalangan pelajar lelaki (30.7%) berbanding dengan pelajar perempuan (27.4%) yang terlebih berat atau obes. BMI pelajar secara signifikannya berkaitan dengan gender ($p=0.02$), susunan kelahiran ($p<0.01$), tahap pendidikan ibu bapa($p<0.001$), status pekerjaan bapa ($p<0.001$), pendapatan bulanan keluarga ($p<0.001$) dan BMI ibu bapa($p<0.001$). Prevalen yang tinggi bagi terlebih berat dan obesiti dalam kalangan pelajar sekolah menengah sebagai bandingan dengan kajian lepas yang dijalankan di Iran mungkin berkaitan dengan faktor sosiodemografi. Hubungan yang kuat dengan BMI ibu bapa mungkin berkaitan dengan kombinasi faktor genetik dan juga gaya hidup.Oleh sebab itu, strategi bagi menerangkan obesiti dalam kalangan kanak-kanak harus mengambil kira interaksi faktor-faktor tersebut dan impaknya terhadap gaya hidup kanak-kanak dan juga remaja.

ACKNOWLEDGEMENT

I humbly thank Allah Almighty, the Beneficent and the Merciful, who gave me health, thoughts and co-operative people to enable me achieve this goal.

This work would not be accomplished without the help of so many people. In the following lines is a brief account of some but not all who deserve my thanks.

First, I would like to thanks Prof. Dr Zalilah Bint Mohd Shariff for taking the burden of supervising this research. Her theoretical insight and her relentless enthusiasm for help created such inspiration to make this direction and finally, to succeed in this study.

I am also delighted to convey my appreciations to my committee, Prof. Dr Hejar Abdul Rahman, Prof. Dr Nasir Mohd Taieb Bin Mohd Taib, and Prof. Dr Majid Ghayour Mobarhan for their unwavering efforts in reviewing this thesis and other supports.

My warmest gratitude goes to all my family members, especially my mother, my wife and my sons for their endless love and persistent support, understanding and encouragement through my life. My heartfelt thanks to all of you, again, with our nice memory that I never could forget them.

I certify that a Thesis Examination Committee has met on 25 NOV 2015 to conduct the final examination of KHOSRO SHAFAGHI on his thesis entitled "RELATIONSHIP BETWEEN DIETARY PATTERNS WITH BODY MASS INDEX, WAIST CIRCUMFERENCE, AND BLOOD PRESSURE AMONG SECONDARY SCHOOL CHILDREN IN MASHHAD, IRAN" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U. (A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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Declaration by Members of Supervisory Committee

This is to confirm that:

- The research conducted and the writing of this thesis was under our supervision;
- Supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

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LIST OF ABBREVIATION

BMI	Body Mass Index
BP	Blood Pressure
CDC	Center for Disease Control and Prevention
CR	Cognitive Restraint
DALLYs	Disability Adjusted Life Years
DASH	Dietary Approach to Stop Hypertension
DBP	Diastolic Blood Pressure
EE	Emotional Eating
FAO	Food and Agriculture Organization
KHANES	Korean National Health and Nutrition Survey
MOHTM	Ministry of Health, Treatment and Medical Education
NCD	Non Communicable Disease
OSA	Obstructive Sleep Apnea
PA	Physical Activity
PAQ-C	Physical Activity Questionnaire for older children
PCA	Principal Component Analysis
RDA	Recommended Dietary Allowances
RNI	Reference Nutrient Intake
SBP	Systolic Blood Pressure
SES	Socio-Economic Status
TFEQ	Three Factors Eating Questionnaire
UE	Uncontrolled Eating
USDHHS	United States Department of Health and Human Services
USPSTF	United States Preventive Services Task Force
WC	Waist Circumference
WHO	World Health Organization
YRBS	Youth Risk Behavior

CHAPTER 1

INTRODUCTION

1.1 Background

Obesity is a worldwide public health concern. By 2015, 75 % of the adult population will be overweight and 41 % obese (WHO, 2007). Globally, high prevalence of overweight and obesity has been explained as a pandemic in several countries (Popkin et al., 2012; Swinburn et al., 2011; Finucane et al., 2011). Global evaluations in the year of 2010 showed that overweight and obesity were resulted in 4% of disability-adjusted life-years (DALYs) , 4% of years of life lost, and in 3.4 million deaths (Lim et al., 2012). Prevalence of overweight and obesity between 1980 and 2013in the world increased to 47.1% for children and 27.5% for adults and (Ng et al., 2014).

Similarly, prevalence of childhood obesity is increased globally. About 22 million children under 5 years old are overweight (WHO, 2013). In developed countries, the prevalence of overweight and obesity has increased remarkably. Overweight in children and adolescents have increased from 1980 in the USA as double and triple, respectively (Jiang et al., 2006). In Canada, child obesity has increased more than doubled since the late 1970 (Public Health Agency of Canada, 2011). A study on 6 – 9 years old children in 13 European countries showed that the prevalence of overweight was 24 % (WHO European, 2012). Nationally representative BMI data indicated sharp increase in prevalence of overweight among Irish (O'Neill et al., 2007) and Spanish (Aranceta- Batrina et al., 2005) adolescents.

The prevalence of overweight and obesity is also rising in children and adolescents in several developing countries (Ng et al., 2014). Sharp increase in prevalence of overweight in adolescents has been revealed in Brazil (4.1 - 13.9% among 1975 – 1997), Chania (6.4 - 7.7% among 1991 – 1997), and India (16 - 24% among 2002 – 2007) (Bhardwaj et al., 2008). in China in 1985, only 1% of girls and 2% of boys were obese or overweight, based on Chinese-specific cut points which indicates a BMI of 24 for overweight and 28 for obesity at age 18, but by 2005, roughly 9% of girls and 14% of boys were overweight or obese (Ji & Cheng, 2009). For Latin America the highest prevalence of obesity was recorded in Chile (11.9 %) and Mexico (10.5 %,) in boys, and in Uruguay (18.1 %) and Costa Rica (12.4 %,) in girls (Ng et al., 2014). About 11% of South African boys and 17% of girls in ages 6 to 13 were obese or overweight (Gupta et al., 2012). In Australasia, Pacific Islands, China and Middle East, prevalence of obesity have rose about 3-fold since 1980 (WHO, 2008). In the Persian Gulf region among adolescents aged 10–14 years in Kuwait, 46% of girls and 44% of boys were overweight or obese (Ng et al., 2012). In Qatar, the prevalence of obesity and overweight among adolescents was7.9% and 28.6% in boys, respectively and 4.7% and18.9% in girls, respectively (Bener, 2006). In Iran about 10% of high school students in a district of Tehran were obese (Amini et al., 2007), and 7.1% of secondary students were obese (Moayyeri et al. 2006).

Multiple factors such as high calorie snack consumption (Johnson et al., 2008), sedentary lifestyle and low physical activity (Campbell et al., 2006) contribute tochildhood obesity. Snack foods contain high fat, specially saturated fat, sucrose and sodium, and contain low amounts of vitamin and minerals, but they displaced the

healthful foods such as fruits, vegetables and nuts in diet (Ovaskinen et al., 2006). A study in North Iran showed that consuming energy dense snack food was highly common during school hours, in overweight/ obese and normal weight girls, (Maddah et al., 2009).Besides, a reverse relationship has been demonstrated between eating habits and the prevalence of obesity and overweight in children (Wurbach et al., 2009; Amini et al., 2007). Sweetened drinks are main contributors of calorie rich diets and have been associated with obesity (Vartanian& Schwartz, 2007). Sedentary lifestyle, especially television watching (TVW), and use of computers and computerized games, has increased the risk of obesity (Campbell et al., 2006).

In recent years, dietary pattern approach has become a common method in nutritional epidemiology. A dietary pattern approach considers overall dietary consumption by taking intakes of combined foods and nutrients into account (Moller et al., 2007). Normally, measuring the dietary patterns is used to evaluate the complex nature of dietary intake and investigate its relation to health. A study suggested that a healthful dietary pattern should include high intakes of fruit, vegetables, reduced-fat dairy products, and fiber (McNaughton et al., 2008). Several studies have reported the relationship between major dietary patterns with obesity and central adiposity (McNaughton et al., 2007; Esmailzadeh& Azadbakht 2008). Besides, several studies have shown association between dietary patterns and systolic and diastolic blood pressure (Lopez et al., 2008; McNaughton 2005; Kim 2009)

Obese adolescents are more possibly to be sick that cause to school absent and encounter more limitation and need more attendance comparing to normal weight children (Wijga et al., 2010). Some studies show that obesity may be related to asthma (Rzehak et al., 2013), obstructive sleep apnea (OSA) (Narang et al., 2012) and musculoskeletal pain (Paulis et al., 2013). Watson et al. (2013) showed that among normal weight children 6% had hypertension in adulthood, while this proportion was 26% among obese children (Cote et al., 2013).Pediatric obesity is associated with high blood pressure, adverse changes in the lipid profile, diminished cardiac function, and insulin resistance (Thompson et al., 2007) . Also, childhood obesity is related to mental problems including weight-based teasing, eating disorder, low self-esteem, and body dissatisfaction (Gotineau et al., 2011).

1.2 Problem Statement

Rapid urbanization and modernization have taken place in Iran over the last decades. Based on the WHO, currently more than 69.1% of Iranian populations reside in urban areas WHO, 2014). These rapid changes have contributed to significant decline in physical activity and changes in food consumption patterns. Per capita daily energy increased from 1772 kcal in 1961 to 3044 kcal in 2007 (FAO, 2007). At the national level, the average energy and protein intakes are higher than the respective RDAs. The distribution is, however, such that 20% have a relatively low intake, 40% overeat and are at risk of, or suffering from, chronic nutritional diseases, the remaining 20% having a nutritionally desirable intake. The average proportions of dietary energy from protein (11%), fat (22%), and carbohydrate (67%) are desirable from a nutritional point of view (FAO, 2014). Per capita daily energy supplied by cereals declined from about 60.3 % in 1961 to 50.6 % in 2007. The daily protein supply through animal products increased from 26.48% in 1961 to 28.49 % in 2007. Per capita consumption of most foodstuffs such as meat, dairy products, vegetables and fruit has increased over the past

decades. Per capita consumption of vegetables and fruit increased from 57.8 and 41.1 kg in 1961 to 193.7 and 158 kg in 2007 respectively and that of milk and meat increased from 51.9 and 14.5 kg in 1961 to 70.5 and 30.4 kg in 2005 respectively. In recent decades, per capita energy consumption increased from 650 kg in 1970 to 2,438 kg in 2005 based on kg of oil equivalent (FAO, 2007). These changes have led to a considerable imbalance in food consumption.

An increasing rate of urbanization and changing lifestyles in Iran increased the risk of overweight and obesity in children (Hajian-Tilaki& Heidari, 2013). Overweight/ obesity, hypertension, and inadequate physical activity are among the first five risk factors causing the highest proportion of burden: 68% of risk factor burdens, 11% of total burden of disease, with 1.6 million dally altogether. Among Iranians aged 15-64 years ,39% had low levels of activity, 44% were overweight, 15 % were obese, 16% had raised blood pressure, 88% consumed less than 5 combined servings of fruit and vegetables per day and 11% currently smoked tobacco daily (Ministry of Health and Medical Education, 2009).

Childhood obesity in Iran is a rising health-concern and will become the main public challenge later (WHO 2007). The prevalence of obesity and overweight among adolescent girls in Mashhad (northeast of Iran) was 14.6% and 3.4%, respectively. Besides, 3.7% of subjects had abdominal obesity (Mirhoseini, 2009). In the study of Amini et al. (2007) 1 in every 4 students in the sample was overweight or obese. The prevalence of overweight and obesity among 13-18-year-old in Shiraz (Central Iran) was 11.3% and 2.9%, respectively (Mostafavi 2005). The prevalence of obesity among secondary school students in Tehran was 7.1% (Moayeri et al., 2006). The prevalence of overweight was significantly higher among girl students than boy students (Taheri& Kazemi 2006). In the study of Maddah (2009), the prevalence of obesity was significantly higher among rural girls than their peers in urban areas. The national study (Childhood and Adolescence Surveillance and Prevention of Adult Non-Communicable Disease: CASPIAN) was performed among 21,111 school students aged 6–18 years in Iran in 2003–2004, and showed that the prevalence of obesity and overweight was 11.3, and 2.9 percent, respectively. The lowest prevalence (3.1 percent overweight and 0.6 percent obesity) was observed in Zahedan and the highest prevalence (18.8% overweight, and 7.4 % obesity) was observed in Rasht (Kelishadi, et al., 2007).

Increasing cardiovascular risk factor such as hypertension is related to overweight and obesity among adolescents. Hypertension in adolescents is new concern in recent decades (Peters& Flack, 2003).To date, there are a limited number of studies on childhood obesity and its accompanying cardiovascular risk factors in Iran. Mirhoseini et al. (2009) showed that the prevalence of hypertension was 6.1% in Mashhad, which was increased with severity of obesity. Among 13086 children aged 7-12 years in Tehran, 81.9% of obese children and 75.4% of overweight children had at least one cardiovascular risk factor. Besides, there were significant correlations between body mass indexes and waist circumference with systolic and diastolic blood pressure (Hamidi et al., 2006).

The rapid increase in childhood obesity in Iran reveals that environmental factors are related to this epidemic (Maddah et. al, 2009). Unhealthful eating behaviors such as high consumption of fast foods, energy-dense snacks, sugary drinks, and

otherenvironmental factors are important contributors to childhood obesity and hypertension in Iran. Sedentary lifestyle such as long TV watching and computerized games, play role in relation to Iranian childhood obesity. This study is planned to study the relationship between childhood obesity and dietary patterns (based on BMI, and WC) and blood pressure among secondary school children in Mashhad. Before formulating any preventive health program to practice, it is necessary to get valid and reliable data on the problem. To knowledge of researcher, no study has been focused on the investigation of relationship between dietary patterns and childhood obesity and blood pressure in Iran.

1.3 Research Objectives

1.3.1 General Objective

To determine the relationship between dietary patterns with body mass index (BMI) , waist circumference (WC) and blood pressure (BP) among secondary school children (12-14 years) in the city of Mashhad, Iran.

1.3.2 Specific Objectives

1. To determine body mass index (BMI), waist circumference (WC), and blood pressure (BP) of secondary school children.

2. To determine dietary patterns of secondary school children.

3. To determine the relationship between socio-demographic, lifestyle factors, eating patterns, and parental BMI with dietary patterns among secondary school children.

4. To determine the relationship between socio-demographic, lifestyle factors, eating patterns, and parental BMI with BMI, WC and BP among secondary school children.

5. To determine the independent relationship between dietary patterns with BMI, WC and BP among secondary school children.

1.4 Hypotheses

1) There are significant associations between socio-demographics, lifestyle factors, eating patterns, and parental BMI with dietary patterns among secondary school children.

2) There are significant associations between socio-demographics, lifestyle factors, eating patterns, and parental BMI with BMI, WC, and BP among secondary school children.

3) There are significant associations between dietary patterns with BMI, WC, and BP among secondary school children.

4) There are significant associations between BMI and WC with BP among secondary school children.

1.5 Conceptual Framework

The conceptual framework for this study is presented in Figure 1.1 The model includes five sections consisting of socio-economic and demographic factors, parents' BMI, lifestyle factors, eating behaviors and dietary patterns. Multiple factors such as high calorie snack consumption (Johnson et al., 2008), sedentary lifestyle and low physical activity especially long watching television, and use of computers has increased the risk of obesity (Campbell et al., 2006). Some studies have shown a relationship between socio-economic status (SES) and obesity (Rosenkranz & Dzewaltowski 2008; Booth et al., 2005). On the other hand, hypertension in adolescents is new concern in recent decades, and has been increased with severity of obesity (Mirhoseini et al., 2009; Hamidi et al., 2006). Despite many attempts to solve adolescence overweight/obesity, it is still major issue in the health system of most developed as well as same developing countries. The risk factor for adolescence obesity can be categorized into five groups.

Socio-economic and demographic consists of adolescents' age, sex and birth order. Also includes parents' age, education attainment, occupation, household monthly income, and household size. These factors were evaluated in this study. The parental BMI was consisting of fathers' BMI and mothers' BMI. Lazzeri et al.(2011) showed that the prevalence of obesity among children increased along the parents' BMI category. The lifestyle consists of physical activity, watching TV, using computer, and cigar rete smoking. Laurson et al. (2008) found that screen time and physical activity were equivalent risk factors for overweight in boys, but physical activity level in girls was more strongly associated with overweight. Physical activity has been shown to lower blood pressure in those with hypertension (Cornelissen& Fagard, 2005).

The eating behaviors show eating restraint factors (including cognitive restraint, uncontrolled eating, and emotional eating), eating frequencies of main meal and snack consumption, energy, macronutrient, and micronutrient intake. All these factors were investigated. The dietary pattern shows identified dietary patterns and its association with risks of general and central obesity, and blood pressure. Some studies showed the associations of healthy dietary patterns with lower risk of overweight/obesity and central adiposity (Okubo et al., 2007; Ritchie et al., 2007) and blood pressure (Anullah-Sekhiri et al., 2011).

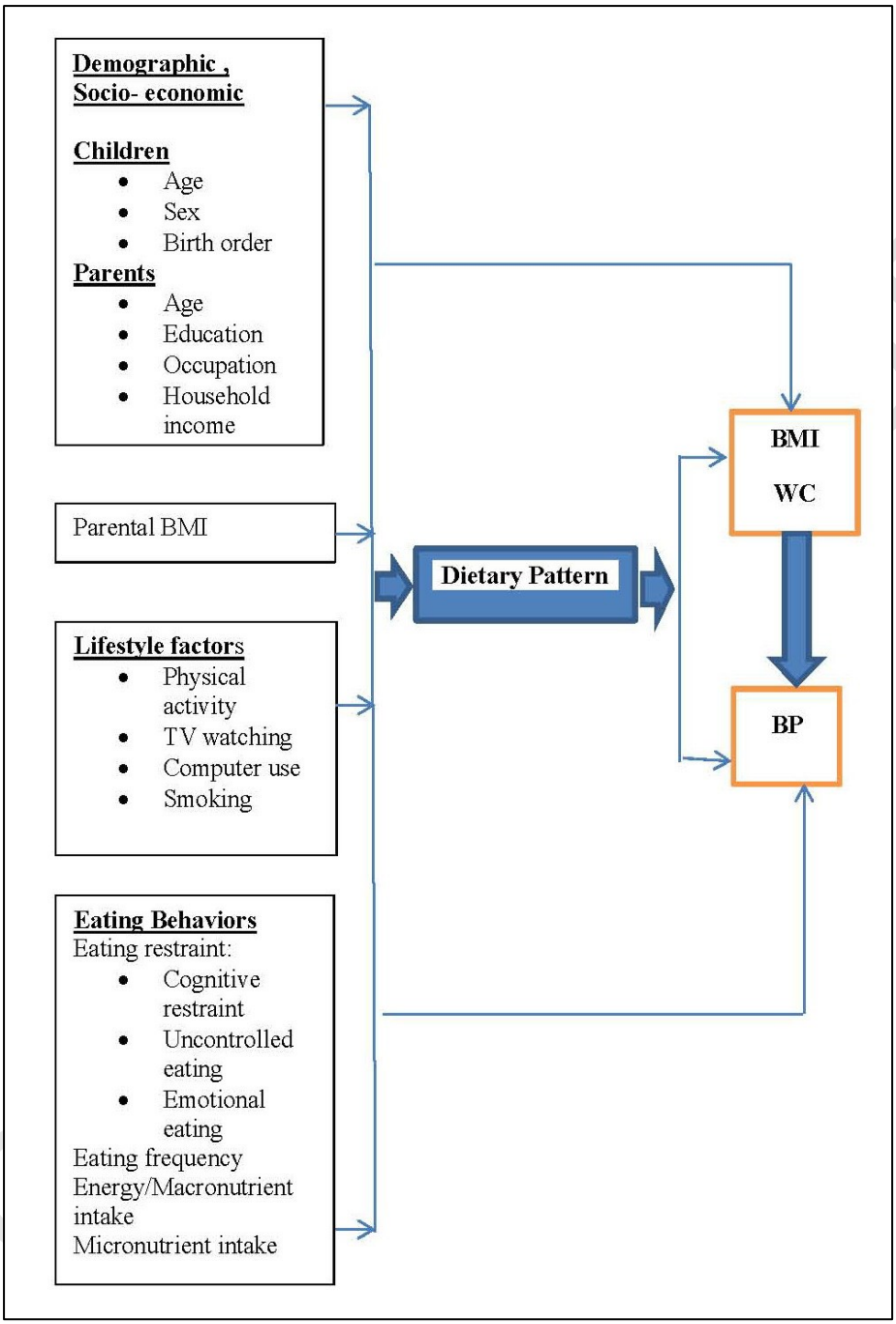

Figure 1.1 Conceptual Framework of Predicting Factors to Determine the Relationship between Dietary Patterns and General and Central Obesity

1.6 Significance of Study

There are a few research studies related to dietary patterns in Iran particularly among adolescents. It would be claimed that all researches had been done in this area were less than the number of two hand fingers. There is also inconsistent association between dietary patterns and obesity. Only one known research (Dr. Ahmad Esmaiilzadeh) in Iran has carried out in this area. Therefore, this study is the first in Iran aiming to determine the relationship between dietary patterns and obesity and blood pressure of adolescents. The findings of this study can be used as baseline data for future studies on dietary patterns, obesity and blood pressure of adolescents in Iran.

Most of the studies in Iran have been focused on energy-dense food and macronutrients, as the main contributing factors to overweight and obesity. The association between eating patterns (for example eating restraint) and obesity and blood pressure is also less known. The present study is the first research on the association between eating restraint and obesity and blood pressure in Iran. Our research also, discussed on the relationship of patterns of dietary with BMI, WC and BP to see whether dietary patterns are potentially contributing factors to overweight and obesity and blood pressure among the adolescents. It is fundamental to identify dietary patterns among adolescents in order to prevent the occurrence of overweight as it might lead to health problems such as hypertension and cardiovascular disease in later ages.

This study also investigated demographic and socio-economic, lifestyle factors, eating patterns, and parental BMI contributing to overweight and obesity among the adolescents. Information obtained about existing eating patterns, lifestyle factors, and disease risk would be useful to public health policy makers and nutritionists to monitor population food consumption trends, and target public health nutrition interventions. However, the use of dietary pattern approach can provide evidence for the development of a public health nutrition policy. These finding can be used by Ministry of Health, Treatment and Medicine Education (MOHTM) of Iran, and Ministry of Education and Training (MOET) to develop policies aiming promotion of health and nutritional status of children and improvement of their health and nutritional status.

1.7 Definition of Terms

1. Adolescent: WHO identifies adolescence as the period in human growth and development that occurs after childhood and before adulthood, from ages 10 to19 (WHO, 2015).In this thesis, the WHO definition was applied.

2. Body Mass Index: It is defined as a person's weight in kilograms divided by the square of height in meters (kg/m^2). In adolescents, BMI also is recommended as an indicator for assessing body weight status (WHO, 2009). In the current study, BMI specified for age and gender was use and classified according to the 2007 W.H.O growth reference (WHO, 2007).

3. Blood Pressure: Is the force of blood pushing against the walls of the arteries as the heart pumps blood. It is measured as systolic (sis-TOL-ik) and diastolic (di-ah-STOL-ik) pressures. "Systolic" refers to blood pressure when the heart beats while pumping blood. "Diastolic" refers to blood pressure when the heart is at rest between beats (NHLBI, 2014). In present study, it was measured according to the standardized

technique of the American Heart Association (National High Blood Pressure, Education Program Working Group on High Blood Pressure in Children and Adolescents (2005).

4. Dietary Pattern: Examining dietary patterns has emerged as an important alternative method in nutritional epidemiology due to the limitations of the traditional approach of assessing single foods or nutrients (Barkoukis, 2007). In current research it was assessed using Iranian semi quantitative FFQ (Esmailzadeh et al. 2007) that included 121 food items.

5. Eating Behavior: Behavioral responses or sequences associated with eating including, patterns of eating, and time intervals (Medical Dictionary, 2011). The behaviors have variety dimensions including number of eating episodes (breakfast, lunch, dinner, and snacks), contribution of each meal and snack to daily energy intake.

6. Physical Activity: is defined as any bodily movement produced by skeletal muscles that result in energy expenditure. For children and young people, physical activity includes play, games, sports, transportation, chores, recreation, physical education, or planned exercise, in the context of family, school, and community activities (WHO, 2012).

7. Waist Circumference (WC): This measurement provides information about the distribution of body fat. It alone could replace waist–hip ratio and BMI as a single risk factor for all-cause mortality (WHO waist circumference, 2008). In present study, WC was measured according to report of WHO expert consultation (WHO, 2008).

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APPENDIX A

Reference No

Date (month/day/year) ------- / ------ / --------

UNIVERSITI PUTRA MALAYSIA

Title:

THE RELATIONSHIP BETWEEN DIETARY PATTERNS WITH BODY MASS INDEX (BMI), WAIST CIRCUMFERENCE (WC), AND BLOOD PRESSURE (BP) AMONG SECONDARY SCHOOL CHILDREN (12-14 YEARS) IN MASHHAD, IRAN

INVESTIGATOR: KHOSRO SHAFAGHI (GS 19932)

Section A: Demographic information (Student)

1. First Name: …… 2. Last Name……
3. Age (Year):
4. Date of Birth (day/month/year): ……..
5. Date of assessment (day/month/year): ……...
6. Sex: Male Female
7. What is your birth order?
   [ ] the first child [ ] the second child [ ] the third child
   [ ] more

Section B: Demographic and Socioeconomic (Parents)

1. Father's age (year) ……
2. Mother's age (year) ……..
3. Father's Occupation: ……
4. Mother's Occupation: ……
5. Father's education level:
   [ ] No school [ ] Primary school [ ] High school
   [ ] Diploma [ ] University degree
6. Mother's education level:
   [ ] No school [ ] Primary school [ ] High school
   [ ] Diploma [ ] University degree
7. How many members include in the family? ……..
8. What is the estimated monthly income of the family? (Rial).....
9. Your address:
10 Your contact No. :

Section C: Anthropometric measurements (parents)

1. Father's anthropometric measures:

Weight (kg)	Height (cm)

2. Mother's anthropometric measures:

Weight (kg)	Height (cm)

Section D: Anthropometric and blood pressure measurements (Students)

Weight (Wt) (kg)	Height (Ht) (cm)	Waist Circumference(WC) (cm)	Blood Pressure (BP) (mmHg)

Section E: Eating& meal patterns

1. Child eating patterns:

1. When I smell a sizzling steak or juicy piece of meat, I find it very difficult to keep from eating, even if I have just finished a meal. Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
2. I deliberately take small helpings as a means of controlling my weight. Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
3. When I feel anxious, I find myself eating. Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
4. Sometimes when I start eating, I just can't seem to stop. Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
5. Being with someone who is eating often makes me hungry enough to eat also. Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
6. When I feel blue, I often overeat. Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
7. When I see a real delicacy, I often get so hungry that I have to eat right away. Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
8. I get so hungry that my stomach often seems like a bottomless pit. Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
9. I am always hungry so it is hard for me to stop eating before I finish the food on my plate.
   Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
10. When I feel lonely, I console myself by eating. Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
11. I consciously hold back at meals in order not to weight gain. Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
12. I do not eat some foods because they make me fat. Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
13. I am always hungry enough to eat at any time. Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
14. How often do you feel hungry? Only at meal times (1)/ sometimes between meals (2)/ often between meals
15. How frequently do you avoid "stocking up" on tempting foods? Almost never (1)/ seldom (2)/ usually (3)/ almost always (4)
16. How likely are you to consciously eat less than you want? Unlikely (1)/ slightly likely (2)/ moderately likely (3)/ very likely (4)
17. Do you go on eating binges though you are not hungry? Never (1)/ rarely (2)/ sometimes (3)/ at least once a week (4)

18. On a scale of 1 to 8, where 1 means no restraint in eating (eating whatever you want, whenever you want it) and 8 means total restraint (constantly limiting food intake and never "giving in"), what number would you give yourself?

Section F: Dietary patterns.

Food Frequency Questionnaire

For coding only	**Type of Food**	**amount**	**day**	**week**	**month**	**rarely/ never**	**Notes**
G.1.	**Processed meats**						
1	Cold cuts	Small slices					
2	Sausages	number					
G.2.	**Red meats**						
3	Beef	Small slice					
4	hamburger	number					Register if slices Mentioned
5	lamb	Small slice					
G.3.	**Organ meats**						
7	Heart liver ,kidney ,of sheep	Slices/ skewer					
8	tongue	Number					
9	brain	Number					
10	Head of sheep (cooked)	Number					
11	trotters	number					register if specific parts or amount used
G.4.	**Fish**						
13	Canned tuna fish	Table spoons					Do you discard the oil? Yes/no
14	Fish type (except tuna and conserved fish)	Slices the size of a cassette					Amount / type /cooking method
15	Shrimps	number					Amount / type /cooking method
G.5.	**Poultry**						
17	Chicken (cooked) with skin/skinned	Average pieces					Whole leg/half leg/whole breast/ half breast/wings
G. 6.	**Eggs**	number					
19	Eggs (cooked or used in the food)	number					White only/ yolk only / whole egg
G.7.	**Butter**						
21	Animal butter (added to food)	match box size					
G.8.	**Margarine**	spoon					
23	plant butter (added to food, e.g. Golden Atlas butter)	match box size					
G.9.	**Low-fat dairy products**						
25	Skim milk	cup					
26	low-fat milk	cup					
27	low-fat yogurt	cup					
G.10.	**High-fat dairy products**						

28	High-fat milk	cup					
29	whole milk	cup					
30	chocolate milk	cup					
31	cream	Table spoons					
32	high-fat yogurt	cup					
33	cream yogurt	cup					
34	Ordinary yogurt	cup					
35	cream cheese	match box size					Feta/Tabriz/local
36	other cheeses	match box size					
37	Pizza cheese (not in pizza)	Table spoons ground					
38	yoghurt diluted with water	cups					Homemade/ industrial
	ice cream						
39	Pasteurized ice cream	number					Cone/kim /magnum/cup
40	Traditional ice cream	Bowls					
41	Pasteurized dried whey	Table spoon					
G. 11.	**Tea**	cup					
G. 12.	**Coffee**	cup					
G.13.	**Fruit**						
44	Pears	number					
45	apricots	number					
46	cherry	10 average-sized (30 gr)					
47	Sweet Cherry	10 average-sized(30 gr)					
48	apples	number (medium gr)					
49	raisins	Table spoon					
50	grapes	Small bunch(30gr)					
51	bananas	Numbe r(medium gr)					Small, average, big
52	cantaloupe	¼ of an average sized(100gr)					
53	watermelon	Average slice(30gr)					
54	oranges	(medium gr)					
55	grapefruit	r(large gr)					
56	Dried grape & mulberry	Table spoon					
57	kiwi	Number(medium gr)					
58	strawberries	cup					
59	peaches	Number(medium gr)					
60	nectarine	Number(medium gr)					
61	tangerine	number (medium gr)					
62	mulberry	cup					
63	Plums(yellow/red)	number (medium					

		gr)					
64	persimmons	number(medium gr)					
65	pomegranates	number(medium gr)					
66	Sweet lemons	number(medium gr)					
67	Pineapples (fresh/conserved)	Cups					
68	Fresh figs	number(medium gr)					
69	dates	number(medium gr)					
G.14.	**Fruit juices**						
71	Apple juice	cups					
72	orange juice	cups					
73	grapefruit juice	cups					
74	Melon juice	Cups					contents
	other fruit juices	cups					
75	Fruit conserved (mention type and amount)	cups					type
76	Sundis (Santop fruit juice, San quick industrial juice, San Ich)	cups					Type Package size
G.15.	**Cruciferous vegetables**						
77	Cabbage	cups					
78	cauliflower	cups					
79	Brussels sprouts	cups					
80	kale	cups					
G.16.	**Yellow vegetables**						
81	Carrots (raw & cooked)	number					
82	Carrot juice	Cups					
	Tomatoes						
G.17.	**Tomatoes**	number					
84	tomato sauce(ketchup)	Table spoon					
85	tomato pasta	Table spoon					
G.18.	**Green leafy vegetables**	cup					
86	Spinach	cup					
87	lettuce	cup					
G.19.	**Other vegetables**	cup					
89	Cucumber	number					
90	mixed vegetables	cups					
91	Vegetables for ash, polo, khoresht	Cups					
92	eggplant	Number(gr)					Fried/dolmeyi
93	celery	cup					
94	green peas	Table spoon					
95	green beans	Table spoon					
96	Green pepper hot	Table spoon					

97	Dolme pepper (sweet)	number					
98	turnip	number					
99	corn	Table spoon					
100	squash	cups					
101	Cooked pumpkins	6x6 cm slice(gr)					
102	marrow bean	Table spoon					boiled/fried
103	Cooked mushrooms	Cups					
104	Raw onions	number					
105	Fried onions	Table spoons					
G.20.	**Legumes**						
107	Beans (cooked)	Cups					
108	Pea (cooked)	Cups					
109	lima beans (cooked0	cups					
110	broad beans (cooked)	cups					
111	Lentils (cooked)	Cups					
112	Soya beans (cooked)	Cups					
G.21.	**garlic**	Grains					
G.22.	**Potatoes**						
114	Cooed potato	Average size, number(gr)					
G.23.	**Fried potato**	10 average slices					
G.24.	**Whole grains**						
117	Dark breads (Iranian)	number					
118	Lavash bread	number					
119	Barbari bread	Number					
120	Sangak bread	Number					
121	Taftoon bread	number					Mashini/Mashhadi
122	Baguette bread	Loaf					
123	Bread with bran	number					Type
124	barley bread	number					
125	popcorn	cups					
126	cornflakes	cups					
127	wheat germ	Table spoon					
128	bulgur	Table spoon					
G.25.	**Refined grains**	Table spoon					
130	noodles	cup					
131	Cooked rice	Plate/ spatula (Table spoon)					Ordinary size/full
132	Cooked spaghetti	Plate/ spatula) (Table spoon)					Ordinary size /full
133	toasted bread	number					
135	milled barley	cup					
136	sweet bread	number					

137	white flour	Table spoon					
138	starch	cups					
139	Reshteh ash / cooked Vermicelli	Cups					
140	Biscuit (creamed, Saghe Talaee)	number					Type, size
G.26.	**pizza**	Average size					Vegetables / meat / mixed
G.27.	**Snacks**						
142	Potato chips	I small pak(how many pieces)					
143	corn puffs	I small pak (how many pices))					
144	crackers	I small pak (how many pieces)					
145	popcorn	I small pak(how many pieces)					
146	pofak	I small pak(how many pieces)					
G.28.	**Nuts**						
178	Peanuts	20 seed					
149	almonds	10 seed					
150	pistachios	10 seed					
151	hazelnuts	10 seed					
152	roasted seeds	Table spoon					
153	walnuts	Whole seeds					
154	chick - pea	Table spoon					Salted / without salt
155	sesame	Table spoon					Salted / without salt
G.29.	**Mayonnaise**	Table spoon					
G.30.	**Dried fruit**						
157	Dried figs	number					
158	dried dates	number					
159	dried mulberries	number					
160	other dried fruit	number					
G.31.	**Olive**						
161	Olives	number					
162	Olive oil	Table spoon					
G.32.	**Sweets and desserts**						
163	Cacao chocolate	number					Type, grams
164	cookies	number					Type, grams
165	Plane cake (Yazdi, packed, home-made)	number					Type
166	Dry pastries	1 average sized(50gr)					
167	Creamed pastries	1 average sized(50gr)					
168	confections	Table spoon					
169	Jam(type)	Table spoon					
170	jelly	Table spoon					
171	honey	Spoons					

172	Gaseous drinks	Glass					
G.33.	**Hydrogenated fats**						
174	Hydrogenated fats	Table spoon					
175	animal fats	Table spoon					
G.34.	**Vegetable oils**	Table spoon					
177	Vegetable oils (except for olive oil)	Table spoon					
G.35.	**Sugars**	spoon					
179	Cube sugar, shekarpanir	Cubes(gr)					
180	candies	number					
181	Nabat/polaki	Cubes(gr)					
182	gaz (an Iranian confectionery made of sugar, nuts, and tamarisk)	number					
G.36.	**Condiments**	spoon					
G.37.	**Soft drinks**	class					
G.38.	**Yogurt drink**						
185	**yoghurt diluted with water**	cups					Homemade/ industrial
G.39.	**Broth**	cups					
G.40.	**Salt**	spoon					
G.41	**Pickles**						
189	Shoor(mention ingredient)	Table spoons					
190	Salted Cucumber	Table spoons					

Interviewer name……..Signature…….Date……

1. **2.24-hour dietary recall:**

   Student ID…….

Time	Meal/Snack	Type of Food/ drinks	Amount (gr, ml Serving size)
	Breakfast		
	Morning tea		
	Lunch		
	Evening tea		
	Dinner		
	Supper		

2. **Food record**

   Student ID…….

Time	Meal/Snack	Type of Food/ drinks	Amount (gr, ml Serving size)
	Breakfast		
	Morning tea		
	Lunch		
	Evening tea		
	Dinner		
	Supper		

Interviewer name……..Signature…….Date……

Section G: Lifestyle

G. 1.Smoking:

1. Have you ever tried cigarette smoking, even one or two puffs?
[ ] Yes [ ] No
2. How old were you when you smoked a whole cigarette for the first time? (Year).....

3. During the past 30 days, on how many days did you smoke cigarettes? ……days

4. During the past 30 days, on the days you smoked, how many cigarettes did you smoke per day?
…… cigarettes

5. During the past 30 days, how did you usually get your own cigarettes?
[ ] Yes [ ] No

6. During the past 30 days, on how many days did you smoke cigarettes on school property?
……..days

7. Have you ever smoked cigarettes daily, that is, at least one cigarette every day for 30 days?
[ ] Yes [ ] No
8. During the past 12 months, did you ever try to quit smoking cigarettes?
[ ] Yes [ ] No

G.2. TV Viewing/ Computer Use

1. How many hours do you spend on watching TV?
[ ] 1-2 hour/day [ ] 3-4 hour/day [ ] 5-6 hour/day
[ ] more than 6 hour/day
2. How many hours do you spend on computer and computerized games?
[ ] 1-2 hour/day [ ] 3-4 hour/day [ ] 5-6 hour/day
[ ] more than 6 hour/day
3. Your lifestyle is:
[ ] Very sedentary [ ] Sedentary [ ] Moderately
[ ] very active

F.3. Physical activity questionnaire for older children (PAQ-C)

Name…… Age……
Sex: ☐ Male ☐ Female Grade…….

We are trying to find out your level of physical activity from ***the last 7 days*** (in the last week). This includes sports or dances that make you sweat or make your legs feel tired, or games that make you breathe hard, like tag, skipping, running, climbing, and others.

Remember:

1. There are no right and wrong answers-this is not a test.
2. Please answer all the questions as honesty and accurately as you can-this is very important.

1. Physical activity in your spare time: Have you done any of the following activities in the past 7 days (last week)? If yes, how many times? (Make only one circle per row.)

	No	1-2	3-4	5-6	≥7
Skipping……					
Rowing/ canoeing ……					
In-line skating ……					
Tag ……					
Walking for exercise ……					
Bicycling ……					
Jogging or running ……					
Aerobics ……					
Swimming ……					
Baseball, softball					
Dance……					
Football……					
Badminton …….					
Skateboarding……					
Soccer……					
Street hockey…….					
Volleyball……					
Floor hockey……					
Basketball……					
Ice skating……..					
Other: ……					

3. In the last 7 days, during your physical activity education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)? (Check one only.)

I don't do PE……..
Hardly ever……
Sometimes……
Quite often……
Always……...

3. In the last 7 days, what did you do most of the time at recess? (Check one only)Sat down (talking, reading, doing schoolwork) ……..
Stood around or walked around…….
Ran or played a little bit……
Ran around and played quite a bit……
Ran and played hard most of the time……

4. In the last 7 days, what did you normally do at lunch (besides eating lunch)? (Check one only.)
Sat down (talking, reading, doing schoolwork) ……..
Stood around or walked around……
Ran or played a little bit……
Ran around and played quite a bit……
Ran and played hard most of the time……

5. In the last 7 days, on how many days right after school, did you do sports, dance, or play games in which you were very active? (Check one only.)
None……
1 times last week……
2 or 3 times last week……
4 times last week……
5 times last week……

6. In the last 7 days, on how many evenings did you do sports, dance, or play games in which you were very active? (Check one only.)
None……
1 times last week……
2 or 3 times last week……
4 times last week……
5 times last week……

7. On the last weekend, how many times did you do sports, dance, or play games in which you were very active? (Check one only.)

None……
1 times last week……
2 or 3 times last week……
4 times last week……
5 times last week……

8. Which one of the following describes you best for the last 7 days? Read all five statements before deciding on the one answer that describes you.

A. All or most of my free time was spent doing things that involved little physical effort……..

B.I sometimes (1-2 times last week) did physical in my free time (e.g. played sports, went running, swimming, bike riding, did aerobics)……

C.I often (3-4 times last week) did physical things in my free time …….

D.I quite often (5-6 times last week) did physical things in my free time……..

E.I very often (7 or more times last week) did physical things in my free time…….

9. Make how often you did physical activity (like playing sports, games, doing dance, or any other physical activity) for each day last week.

	None	little bit	Medium	Often	Very often
Monday……					
Tuesday……					
Wednesday……					
Thursday ……..					
Friday……					
Saturday……					
Sunday……					

10. Were you sick last week, or did anything prevent you from doing your normal physical activities? (Check one)

Yes……..
No……

If yes, what prevented you?

LIST OF PUBLICATION

The contents of this thesis have been published in the journals and proceedings of following international conferences:

Khosro Shafaghi, Majid Ghayour-Mobarhan, Zalilah Mohd Shariff, Mohd Nasirc, Abdul Rahman Hejar c, Hadi Jabarid . Prevalence of overweight and obesity among secondary school children (12–14 yr) in Mashhad, Iran, 2010–11 .*Clinical Biochemistry* 44(13S), September 2011, S238. doi:10.1016/j.clinbiochem.2011.08.581.

Khosro Shafaghi, Zalilah Mohd Shariff,Mohd Nasir B. Mohd.Taib, Hejar Abdul Rahman, Majid Ghayour Mobarhan,HadiJabbari .Parental body mass index is associated with adolescent overweight and obesity in Mashhad, Iran. *APJCN* 2014, 23 (2) :225-31.doi: 10.6133/apjcn.2014.23.2.11

Khosro Shafaghi , Majid Ghayour Mobarhan , Zalilah Mohd Shariff , Mohd Nasir , Hejar Abdul Rahman , Hadi Jabbari .Prevalence of overweight and obesity among secondary school children (12-14 yr.) in the city of Mashhad, Iran, 2010-11 . The 12th Iranian Congress and 4th International Congress of Biochemistry and Molecular Biology , 6-9th Sep. 2011 , Mashhad, Iran.