



UNIVERSITI PUTRA MALAYSIA

***PREVALENCE AND PREDICTORS OF CARDIOVASCULAR DISEASE
RISKS AMONG SECONDARY SCHOOLS ADOLESCENTS IN KUWAIT***

HAMAD HUSSAIN MONSOUR ALKHARIJI

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By

HAMAD HUSSAIN MONSOUR ALKHARIJI

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

December 2021

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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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December 2021

Chairman : Professor Normala binti Ibrahim, PhD
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In the global scene, cardiovascular disease (CVD) is one of the leading causes of mortality, particularly among adults, while obesity, which could lead to mortality, is among adolescents. Investigation on CVDs risk factors among adolescents becomes indispensable as it is a critical stage in the development of obesity. In Kuwait, information on the prevalence and predictors of CVDs risk factors among adolescents is lacking. Therefore, there is an urgent need for a comprehensive study to investigate the issues to draw out plans and programs for the prevention of CVDs. The present study was conducted primarily to investigate the predominating issues on CVDs risk factors which encompassed smoking, physical inactivity, low diversity diet, hypertension, and obesity among adolescents. This study was conducted in a cross-sectional design on selected public secondary schools in six Governorates (Al- Ahmadi, Al- Jahraa, Hawally, Al- Asimah, Al- Farwania, and Mubarak Al- Kabeer) in Kuwait. Adolescents aged 14 to 17 years old were the study's respondents, selected following cluster sampling method. Gathered information from a total of 4958 respondents were analyzed using Chi-square test and multiple logistic regression to establish the significance of predictors of CVDs risk factors. Data revealed that only a minority of the respondents were recorded to be obese (n=115; 2.3%). Most of them were reported without any case of hypertension (95.5%) but had consumed rich diets (71.5%). The results showed that physical inactivity was more prevalent among girls (85.1%) than boys (78.9%). Of the total respondents, there were only 54 who ever-smoked (1.1%). Multiple logistic regression demonstrated that girls were less likely to be never-smoke in regards to the total respondents. Sixteen-year-old girls were less likely to perform high in physical activity compared with 18-year-olds, coming from families with incomes of ≥ 1600 KWD compared with respondents whose families' incomes were < 1600 KWD. School districts of Al-Asimah, Hawally, Al-Jahraa, and Al-Ahmadi were more likely to perform high in physical activity as compared with school district of Mubarak Al-Kabeer. Girls of school Grade12 from household size of 1-2 members were more likely to be rich in diet diversity score compared with Grade10 from household of size 7 members and above. School districts of Al-Farwania and Al-Asimah were less likely to be on rich diversity diets as

compared with school district of Mubarak Al-Kabeer, while school districts of Al-Farwania, Al-Asimah, Hawally, Al-Jahraa, and Al-Ahmadi were more likely to have no cases of hypertension compared with school district of Mubarak Al-Kabeer. Girls' respondents compared with boys from school district of Al-Ahmadi compared with school district of Mubarak Al-Kabeer were not likely to be obese. The study concluded that the prevalence of CVDs risks (smoking, low diversity diet, hypertension, and obesity) among secondary school adolescents was low in Kuwait. However, physical inactivity was high among secondary school adolescents in Kuwait. The study has provided an insight in planning an effective intervention in the prevention of CVDs risk factors among adolescents.



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**KAJIAN SELURUH NEGARA MENGENAI PREVALENS DAN RAMALAN
RISIKO BAGI PENYAKIT KARDIOVASKULAR DI KALANGAN REMAJA
SEKOLAH DI KUWAIT**

Oleh

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Di persada global, penyakit kardiovaskular (CVD) adalah salah satu penyebab utama kematian di kalangan dewasa, sementara obesiti, adalah penyebab yang boleh membawa kematian di kalangan remaja. Kajian mengenai faktor risiko CVD di kalangan remaja amat diperlukan oleh kerana ianya adalah peringkat kritikal dalam perkembangan obesiti. Memandangkan terdapat kekurangan maklumat mengenai insiden dan ramalan risiko CVD di Kuwait, satu kajian yang menyeluruh mengenai isu tersebut adalah diperlukan bagi merancang dan menjalankan program dalam pencegahan CVD. Kajian ini dijalankan untuk meneliti isu yang mendominasi faktor risiko CVD, yang merangkumi tabiat merokok, ketidakaktifan fizikal, kepelbagaian diet yang rendah, hipertensi, dan obesiti di kalangan remaja. Kajian ini dilakukan dalam rekabentuk keratan rentas ke atas sekolah menengah awam terpilih di enam muhafazah Kuwait (Al-Ahmadi, Al-Jahraa, Hawally, Al-Asimah, Al-Farwania, and Mubarak Al-Kabeer). Remaja berumur 14 hingga 17 tahun adalah responden kajian, dipilih mengikut kaedah persampelan kelompok. Maklumat daripada 4958 responden telah dianalisis dengan menggunakan Chi-square dan regresi logistik berganda bagi menentukan tahap signifikan pada faktor ramalan risiko CVD. Data menunjukkan bahawa sebilangan kecil responden direkodkan adalah obes ($n=115$; 2.3%). Kebanyakan responden tidak mempunyai hipertensi (95.9%) tetapi memakan diet yang kaya nilai nutrien (71.5%) Keputusan menunjukkan ketidakaktifan fizikal adalah lebih meluas di kalangan responden wanita (85.1%) daripada responden lelaki (78.9%). Daripada jumlah keseluruhan responden, hanya 54 responden pernah merokok. (1.1%). Regresi logistik berganda menunjukkan responden wanita kurang berkemungkinan untuk tidak merokok. Responden berumur 16 tahun didapati kurang berkemungkinan untuk melakukan aktiviti fizikal berbanding responden berumur 18 tahun, dari keluarga berpendapatan ≥ 1600 KWD berbanding responden dari keluarga berpendapatan < 1600 KWD. Sekolah dari daerah-daerah Al-Asimah, Hawally, Al-Jahraa, and Al-Ahmadi didapati berkemungkinan untuk melakukan aktiviti yang banyak berbanding dengan sekolah dari daerah Mubarak Al-Kabeer. Responden wanita dari Gred 12 daripada keluarga yang mempunyai isi

rumah satu hingga dua orang didapati memperoleh skor kepelbagaian diet yang tinggi berbanding Gred 10 daripada keluarga yang mempunyai tujuh ahli ke atas. Sekolah dari daerah Al-Farwania dan Al-Asimah didapati kurang cenderung terhadap diet bernutrien kaya dengan kepelbagaian berbanding sekolah dari daerah Mubarak Al-Kabeer. Sementara itu, sekolah dari daerah Al-Farwania, Al-Asimah, Hawally, Al-Jahraa, dan Al-Ahmadi didapati cenderung terhadap tiada kes hipertensi berbanding sekolah dari daerah Mubarak Al-Kabeer. Responden wanita, jika dibandingkan dengan responden lelaki dari sekolah daerah Al-Ahmadi berbanding dari sekolah daerah Mubarak Al-Kabeer tidak cenderung menjadi obes. Kajian ini membuat kesimpulan bahawa risiko prevalens CVD (merokok, kepelbagaian diet yang rendah, hipertensi, dan obesiti) di kalangan remaja sekolah menengah di Kuwait adalah rendah. Walaubagaimanapun, ketidakaktifan fizikal di kalangan remaja sekolah menengah di Kuwait adalah tinggi. Kajian telah menyediakan satu wawasan dalam perancangan dari segi intervensi risiko pencegahan CVD dikalangan remaja.

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LIST OF ABBREVIATIONS

ACC	American College of Cardiology
AOR	Adjusted Odds Ratio
BMI	Body mass index
CI	Confidence interval
DALYs	Disability-Adjusted-Life Years
GCC	Gulf Cooperation Council
HTN	Hypertension
ICC	Intra-Class Coefficient
KD	Kuwaiti Dinars
KISR	Kuwait Institution for Scientific Research
MET	Metabolic Equivalent of Task
MOH	Ministry of Health
NCD	Non-communicable disease
SD	Standard deviation
UK	United Kingdom
UPM	Universiti Putra Malaysia
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Background of problem

A large number of human health-related issues which are generally confronted during adolescence originate from early lifestyles. Cardiovascular diseases (CVD), generally defined as conditions affecting hearts or blood vessels, are among non-communicable diseases (NCDs) which are universally reported to be the leading cause of death globally, besides other ill-health conditions such as diabetes, cancer, chronic respiratory diseases, and mental disorders (Barlogis, et al. (2017). Literature has it that CVDs have the highest mortality rates among NCDs and are associated with diseases such as stroke, acute kidney failure, diabetes, and pulmonary diseases (Odutayo, et al., 2016; Mathew, et al., 2017; Muscogiuri et al., 2017; Song et al., 2017; Johnson et al., 2018).

In 2018, World Health Organization (WHO) reported that CVDs accounted the highest number of death (17.9 million people annually) among deaths caused by other NCDs (WHO, 2018). Other studies also reported that death caused by CVDs accounted to about 41 million, equivalent to about 71% of all death globally, the highest death rate compared to other NCDs. In 2013, approximately 17.3 out of 54 million (31.5%) global deaths were due to CVDs (Benjamin et al., 2017). In 2016, deaths attributed to CVDs were approximately 17.6 million, which amounted to an increase of 14.5% (Benjamin et al., 2019).

Arnett et al., (2019) cited that in the United States of America, CVDs caused daily death rate of more than 2,000, which accounted for than 33% of daily total. Similarly, in the United Kingdom, Danese, et al., (2020) reported that one person experienced a heart attack in every three minutes, amounting to nearly 25% of total mortality. In recent years in the Arab world, the burden of CVDs has been on the increase (Abdul Rahim et al., 2014; Al-Shamsi et al., (2019); Ghandour et al., (2019). All in all, CVDs have become one of the main concerns in public health globally, and generally accepted as the major contributor to human mortality.

Despite being the major cause of mortality globally, CVDs have affected people of all age groups, regions, and countries (Lloyd-Sherlock et al., 2019). Documented studies recorded that the total annual 15 million CVD deaths, were persons of ages between 30 and 69 years old. Although young children and adolescents have not been spared from CVDs, the issues are greater among the elderly, who are more likely to present with other accompanying symptoms (Jelinek et al., 2017; Chao et al., 2018; Goldweig et al., 2018; Bazargan et al., 2019; Serebriiskii et al., 2019). The phenomenon in which the elderlies were highly affected was generally due to elderly body system being more inadequate in regenerative capacity and weaker immunity. Factors related to diet and lifestyle have

been linked to the country's development status, family education, and culture, leading to increased CVD risks (Yusuf et al., 2020).

Studies have shown that a country's economic status affects the risk of developing CVDs as well as morbidity and mortality resulting from CVDs. It had been observed that adolescents in both developed and developing countries were more exposed to risk factors such as stress, family, neighborhood, and peer pressure (Holliday & Gould, 2016; Larson et al., 2016; Cambron et al., 2018). In developed and developing countries, almost every household is in the presence of modern technology such as mobile phones, computers, and television, contributing to the increase of the generally labelled "*couch potatoes*" population, who "*hit the gym or exercise daily but spend maximum of the other wake hours sitting*" in society, leading to the development of those risk factors. In addition, processed food has been widely produced and consumed and, in combination with stresses faced by adolescents due to hectic and competitive lifestyle, can be detrimental to well-being leading to CVDs (Rauber, 2015; Rauber et al., 2015; De Rezende, 2016; De Rezende et al., 2016; Srouf et al., 2019)

Yusuf et al., (2020) documented that in low- and middle-income countries, household air pollution, poor diet, low education, and low grip strength had significant effects on CVDs and its mortality rate than those from high-income countries. This could be due to absence or lack of medical infrastructure and knowledge among citizens. Financial constrain was also another factor where citizens were unlikely to seek medical check-ups hence preventing early detection of CVDs and their contributing factors. Rapid unplanned urbanization, globalization, and population aging have also been cited to contribute to increased stress, unhealthy diet, and physical inactivity (Araullo & Potter, 2016). These have been reported to be the leading cause of raised blood pressure, increased blood glucose, elevated blood lipids, and obesity which were metabolic risk factors of CVDs (Li et al., 2016; Mendis, 2017). Another reason behind high CVD mortality in countries with sluggish or low- and middle-economies was due to poor dietary habits in addition to poor healthcare system, lack of trained health care workers, health system capacity, and infrastructures (Puchalski et al., 2016; Turner et al., 2018; Bitton et al., 2019). The situations suggest that the country's economic status, population education levels, lifestyles, and social-economic levels are interlinked, which are the predeterminant factors to CVDs development. Against this background, there has been lack of regional studies on this area and other predetermined CVD factors, which emphasized on the importance of such diseases.

A number of studies reported that, with Kuwait's population lifestyles, tobacco smoking was the leading cause of CVDs (Lubin et al., 2016 and Banks et al., 2019). Banks et al., (2019) elaborated on the risks of virtually all CVD subtypes, including acute myocardial infarction (commonly called heart attack), paroxysmal tachycardia, and heart failure. Lubin et al. (2016) also reported that smoking fewer cigarettes per day, but for longer durations was more deleterious than those who smoked for shorter durations. Men in Arab countries have been reported to be more prone to develop CVDs due to higher prevalence of male smokers than females, who began smoking at the age as young as 13

to 15 years old (Aljefree & Ahmed, 2015; Al-Shamsi et al., 2019; Mahmoud & Sulaiman, 2019; Alhabib et al., 2020)

Unbalanced diet and alcohol consumption have been reported to contribute to the increased risk of CVDs. Kuwait's unbalanced diet was more of great concern than alcohol consumption, as alcohol is illegal in that part of the world. Studies have reported that an unbalanced diet significantly contributed to increased risk of CVDs (Alhabib et al., 2020; Diamond et al., 2020). According to Diamond et al., (2020), consumption of saturated fat generally increased risks of developing CVDs in the context of left coronary artery disease (LCD). An example of these foods includes fast food, a trend among adolescents and a crucial part of college students' modern days diet (Fuhrman, 2018; Shaban & Alkazemi, 2019).

Physical inactivity has been quoted to be another lifestyle-contributing risk factor for CVDs where the mechanisms underlying inactivity-induced cardiovascular dysfunction involve alterations at different levels (González et al., 2017; Peçanha et al., 2020). Inactivity generally leads to increased autophagy, which reduces cardiac cells' rate, leading to myocardial cell atrophy. In addition, inactivity could cause impairment in metabolism, which leads to increase in visceral fat deposition, hyperglycemia, dyslipidemia, and muscle wasting, and subsequently, increases the risks of CVDs (Kallio et al., 2018; Peçanha et al., 2020). Presently, many adolescents in Kuwait are physically inactive due to high usage of modern screen devices such as televisions, computers, and mobile phones (Delfino et al., 2018; Dos Santos Silva et al., 2018, Hashem et al., 2018). In addition, being a *couch potato* leads to obesity which further increases the risks of CVDs.

Other lifestyle factors, such as the presence of preexisting NCDs (such as obesity, elevated blood lipids, diabetes, high blood pressure, and acute kidney failure), have been said to increase CVDs risks (Akhuemonkhan & Lazo, 2017; Benson et al., 2019; Lee et al., 2019). Deaths resulting from CVDs are generally preceded by long periods of ill-health. Composing these risk factors, to a certain degree, affected employment and family life (Benson et al., 2019; Lee et al., 2019). Recently, CVDs have been labelled as one of the leading causes of disability-adjusted life years (DALYs) lost (Roth et al., 2017). The authors reported that different types of CVDs, such as ischemic heart disease, ischemic and hemorrhagic stroke which ranked the second and third largest cause of DALYs followed by hypertensive heart disease, cardio myopathy, aortic aneurysm, atrial fibrillation, rheumatoid heart disease, endocarditis and peripheral arterial disease. The authors also reported wherein 2015, the number of CVD cases was estimated to be between 415.53 to 427.87 million and 17.59 to 18.28 million CVD death. Another study reported that one in three deaths reported globally in 2015 was due to CVDs (Abajobir et al., 2017). NCDs such as elevated blood lipids, diabetes, and acute kidney failure were not common among adolescents. Adolescents exposed to stress and unhealthy lifestyles such as unhealthy diet were more prone to obesity and hypertension, contributing to CVDs (Poirier et al., 2006 and Alhabib et al., 2020).

According to recent studies, although obesity is traditionally believed to be one of CVDs risks, it is mediated by body fat mass (Piché et al., 2018; Koliaki et al., 2019) According to Koliaki et al., (2019), obesity depended on body fat distribution and adipose tissue expansion. As such visceral fat was often associated with increased CVDs risks, but not subcutaneous fat (Mongraw-Chaffin et al., 2017). The deposition and accumulation of visceral fats also depended on various parameters such as gender and lifestyle, including dietary behaviors (Yamaguchi et al., 2020). Since-adolescents are at a critical stage for developing NCDs associated with CVDs, such as obesity and exposure to various peer pressure, the present study's target population was mainly adolescents, following work of Hsieh & van Kippersluis (2018).

With the background of disabling and life-threatening effects of CVDs, attempts should be taken to prevent occurrence of such diseases. Hence, understanding its predictors on the risks leading to CVDs should be the first step in tackling the issue. The prevalence of CVDs and their mortality rate in Kuwait have been relatively high compared to most other Arab countries, with 46% of NCD deaths were attributed to CVDs in 2008 and were increasing yearly (Aljefree & Ahmed, 2015). The authors also reported that countries such as Bahrain and Kuwait recorded the highest rates of CVDs risk factors. Hence, the present study was undertaken to determine the potential predictors of CVDs risks among secondary schools' adolescents in Kuwait. Risk factors have been highlighted by Gutierrez et al., (2018) to include smoking, physical inactivity, diversity diet, hypertension, and obesity.

Due to the lack of information on the prevalence and predictors of CVDs risk factors among adolescents in Kuwait, implementing any CVD risk factors in prevention programs in the Arabian Gulf, particularly in Kuwait, has been a very challenging endeavor. Therefore, there was a need to investigate the prevalence and predictors of CVDs risk factors among secondary school adolescents to effectively plan for the community's CVD prevention programs for those with high risk. The present study attempted to help in the prevention, treatment, and control of CVDs through early detection of risk factors. The present initiative was the first national epidemiological study that sought to investigate the prevalence and predictors of CVDs risk factors among adolescents in Kuwait with respect to smoking, obesity, physical inactivity, low diversity diet, and hypertension.

1.2 Statement of problem

The burden of CVDs has increased substantially in the Arab world. In 2010, ischemic heart disease contributed to 14.3% of deaths and was the leading cause of death in that part of the world, The public healthcare systems performance has been quoted to be lower than expected (Mokdad et al., 2014).

Saudi Arabia was reported to be among the highest prevalence in physical inactivity (Al-Zalabani et al., 2015) especially in the Gulf Cooperation Council's high-income countries (GCC) which included Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and

United Arab Emirates). The trend was recorded to be higher in women than in men (Abdul Rahim et al., 2014).

A cross-sectional study reported that physical inactivity in males and females was 66.6% (95% Confidence interval (CI) 65.3% to 68%) and 60.1% (95% CI 58.1% to 62.1%) respectively (Al-Zalabani et al., 2015). In the Arab region, the prevalence of waterpipe smoking was between 6% and 34% among adolescents aged 13–15 years old. Waterpipe smoking was perceived as less harmful than cigarette smoking (Abdul Rahim et al., 2014).

Unhealthy dietary habits have been more prevalent in adolescents living in high-income countries of the Queen's Commonwealth Canopy (GCC). They primarily consumed food outside of their homes. Fast food and carbonated beverages were their preferred food. They seldom consumed milk, fruits, and vegetables. They have habits of skipping breakfast and eating while watching television (Schulte, 2016). The global CVDs epidemic has emerged as a public health concern in children and adolescents. CVD in adolescents has been shown to continue into adulthood. This alarming rate of occurrence of CVDs can predict the adverse health effects later in life.

Recent studies reported that CVDs in Kuwait were mostly related to unhealthy behaviors. The dietary patterns consisted mainly of fast-food and refined grains/poultry associated with high prevalence of CVDs risk factors (Badreya Al-lahou et al., 2019). Since 2014, Kuwait was ranked amongst the top countries in the world in obesity prevalence, accounting for almost eight in ten Kuwaiti adults were overweight or obese (Weiderpass et al., 2019). Although not as bad as its adult population, half of the adolescent population was reported to be obese which led to various illnesses as they enter adulthood (Rey-Lopez et al., 2019). In another study, it was reported that Kuwait was one of the leading countries in obesity and tobacco use as well as physical inactivity among adolescents not being spared (Salman et al., 2020). With high prevalence in unhealthy behaviors leading to high prevalence in CVDs and with adolescence being the pillar of society, the present study investigated predictors for CVD risks among adolescents in Kuwait.

1.3 Significance of research

The outcomes of prevalence and predictors of CVDs risk among adolescents from a nationwide perspective contributed epidemiological data for Kuwait public health policymakers. The data collected from the study identified how socio-demographic characteristics predicted the development of CVDs risks.

The present study built the body of knowledge on CVDs predictors that can be used to design and execute effective national CVDs prevention programs for secondary schools. The initiative could lower the risk of CVDs, improving the quality of life among the citizen as well as to reduce the government social economic burden.

1.4 Research objectives

The general objective of the present study was to determine the prevalence and predictors of CVD risks (smoking, physical inactivity, low diversity diet, hypertension, and obesity) among secondary school adolescents in Kuwait.

The specific objectives of the study included:

- i. To determine the socio-demographic characteristics of the secondary schools adolescents in Kuwait;
- ii. To determine the prevalence of CVD risks (smoking, physical inactivity, low diversity diet, hypertension, and obesity) among secondary schools adolescents in Kuwait;
- iii. To determine the association between socio-demographic characteristics (age, gender, school grade, parents' education, household size, socioeconomic status and school district) and CVD risks (smoking, physical inactivity, low diversity diet, hypertension, and obesity) among secondary schools adolescents in Kuwait;
- iv. To examine the predictors (socio-demographic factors: age, gender, school grade, parents' education, household size, socioeconomic status and school district) of CVD risks among secondary schools adolescents in Kuwait;

1.5 Research hypotheses

H1: There is an association between socio-demographic factors (age, gender, school grade, parents' education, household size, socioeconomic status and school district) and smoking among secondary schools adolescents in Kuwait;

H2: There is an association between socio-demographic factors (age, gender, school grade, parents' education, household size, socioeconomic status and school districts) and physical inactivity among secondary schools adolescents in Kuwait;

H3: There is an association between socio-demographic factors (age, gender, school grade, parents' education, household size, socioeconomic status and school district) and low diversity diet among secondary schools adolescents in Kuwait;

H4: There is an association between socio-demographic factors (age, gender, school grade, parents' education, household size, socioeconomic status and school district) and hypertension among secondary school adolescents in Kuwait;

H5: There is an association between socio-demographic factors (age, gender, school grade, parents' education, household size, socioeconomic status and school district) and obesity among secondary school adolescents in Kuwait;

H6: Socio-demographic factors (age, gender, school grade, parents' education, household size, socioeconomic status and school district) are significant predictors for CVD risk among secondary school adolescents in Kuwait

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