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PHYSICAL ACTIVITY PREVALENCE AMONG MIGRANTS IN UNITED ARAB EMIRATE

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Under the Supervision of Professor Syed M. Shah

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Declaration of Original Work

I, Rowaa Elhidia Elobaid Abd-Allatif, the undersigned, a graduate student at the United Arab Emirates University (UAEU), and the author of this dissertation entitled "*Physical Activity Prevalence among Migrants in United Arab Emirates*", hereby, solemnly declare that this dissertation is my own original research work that has been done and prepared by me under the supervision of Professor Syed M. Shah in the College of Medicine and Health Sciences at UAEU. This work has not previously been presented or published, or formed the basis for the award of any academic degree, diploma or a similar title at this or any other university. Any materials borrowed from other sources (whether published or unpublished) and relied upon or included in my dissertation have been properly cited and acknowledged in accordance with appropriate academic conventions. I further declare that there is no potential conflict of interest with respect to the research, data collection, authorship, presentation and/or publication of this dissertation.

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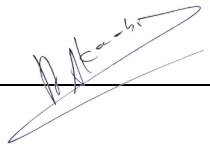
Signature  Date 30 June 2020

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Abstract

Insufficient physical activity is a leading risk for non-communicable diseases (NCDs). Few data were available on the physical activity levels of migrants in United Arab Emirates (UAE). This study aimed to determine leisure time physical activity levels and its associated socio-demographic determinants and NCDs risk factors among migrants in Al Ain, UAE. A random sample of male South Asian migrants (n=1375) (76.4% response rate) and female South Asian, Arab and Philippines migrants (n=555) (75% participation rate) was recruited from government Visa Screening Center in Al Ain, UAE. Adapted version of WHO STEPS Survey with short version of International Physical Activity Questionnaire (IPAQ) was used to measure leisure time physical activity. American College of Sports Medicine guidelines was used to assess physically active (moderate activity of 30 minutes on five days or vigorous intensity aerobic physical activity for a minimum of 20 minutes on three days each week). The average age was 34.0 (±9.9) years for male and 33.6 (±9.6) for female South Asian migrants. The average age was 36.5 (±11.1) for Arab and 33.1 (±8.3) years for Philippine migrants, respectively. Levels of moderate and vigorous physical activity was low in male South Asians (34.7%; 95% Confidence Interval (32.3-37.3), South Asians females (10.2%; 95% CI: 5.9-16.9), Arab females (11.0%; 95% CI, 6.7-17.6) and female Philippine (45.9%; 95% CI: 40.2-51.7), respectively compared to global prevalence. Sociodemographic factors positively associated with low physical activity among male South Asians included working as a driver (AOR: 2.64, 95% CI: 1.69-4.11), shop keeper (AOR: 4.27, 95% CI: 2.18-8.34), having nationality of India (AOR: 1.49, 95% CI: 1.06-2.11) or Pakistan (AOR: 1.65, 95% CI: 1.15-2.37), migration from an urban area of home country (AOR: 1.59, 95% CI: 1.16-2.19), having abdominal obesity (AOR: 1.34, 95% CI, 1.01-1.79) and high cholesterol levels (AOR: 2.35, 95% CI: 1.25-4.45). Female migrants with Philippine nationality (AOR: 0.08, 95% CI, 0.02-0.34) or having single accommodation (AOR: 0.09, 95% CI: 0.02-0.47) or living with a sponsor (AOR: 0.28, 95% CI: 0.08-0.95) were less likely to report higher levels of physical activity. In The low levels of physical activity is a major public health problem among migrants particularly in South Asians and female Arabs and those working as driver, in offices and as shopkeepers with consequences for NCDs.

Keywords: Physical activity, Migrants, United Arab Emirates.

Title and Abstract (in Arabic)

النشاط البدني بين المهاجرين في دولة الإمارات العربية المتحدة

الملخص

يعد النشاط البدني غير الكافي أحد المخاطر الرئيسية للأمراض غير المعدية. كانت هناك بيانات قليلة متاحة عن مستويات النشاط البدني للمهاجرين في الإمارات العربية المتحدة. تهدف هذه الدراسة إلى تحديد مستويات النشاط البدني وقت الفراغ ومحددات العوامل الاجتماعية والديموغرافية المرتبطة به وعوامل الخطر للأمراض غير السارية بين المهاجرين في العين، الإمارات العربية المتحدة. قمنا بتوظيف عينة عشوائية من المهاجرين من جنوب آسيا الذكور (عددهم=1375) (معدل الاستجابة 76.4٪) والمهاجرات من جنوب آسيا والعرب والفلبين (العدد=555) (معدل المشاركة بنسبة 75 ٪) من مركز فحص التأشيرات الحكومي في العين، الإمارات العربية المتحدة. استخدمنا نسخة معدلة من WHO STEPS Survey مع نسخة قصيرة من استبيان النشاط البدني الدولي (IPAQ) لقياس النشاط البدني في أوقات الفراغ. استخدمنا إرشادات الكلية الأمريكية للطب الرياضي لتقييم النشاط البدني (النشاط المعتدل لمدة 30 دقيقة في خمسة أيام أو النشاط البدني الهوائي القوي لمدة 20 دقيقة على الأقل في ثلاثة أيام كل أسبوع). كان متوسط العمر 34.0 (± 9.9) سنة للذكور و 33.6 (± 9.6) للمهاجرات من جنوب آسيا. كان متوسط العمر 36.5 (± 11.1) للعرب و 33.1 (± 8.3) للمهاجرين الفلبينيين ، على التوالي. كانت مستويات النشاط البدني المعتدل والفعال منخفضة لدى الذكور الآسيويين الجنوبيين (34.7 ٪ ؛ 95 ٪ CI 32.3-37.3) ، إناث آسيا الجنوبية (10.2 ٪ ؛ 95 ٪ CI، 16.9 - 5.9) ، الإناث العربيات (11.0 ٪ ؛ 95 ٪ CI، 6.7-17.6) والإناث الفلبينيات (45.9٪ ؛ 95٪ CI 40.2 - 51.7) ، على التوالي مقارنةً بالانتشار العالمي. العوامل الاجتماعية الديموغرافية المرتبطة إيجابًا مع انخفاض النشاط البدني بين الذكور الآسيويين الجنوبيين تشمل العمل كسائق (AOR: 2.64، 95٪ CI ، 1.69-4.11) ، أمين متجر (AOR: 4.27، 95٪ CI 2.18- 8.34) ، يحمل جنسية الهند (AOR: 1.49، 95٪ CI ، 1.06-2.11) أو باكستان (AOR: 1.65، 95٪ CI ، 1.15-2.37) ، الهجرة من منطقة حضرية في البلد الأم (AOR: 1.59، 95٪ CI ، 1.16-2.19) ، يعانون من السمنة في البطن (AOR: 1.34، 95٪ CI ، - 1.01 1.79) ومستويات الكوليسترول المرتفعة (AOR: 2.35، 95٪ CI ،1.25-4.45) - المهاجرات ذوات الجنسية الفلبينية (AOR: 0. 08، 95 CI٪ ، 0.02-0.34) أو لديهن سكن فردي (AOR:

0.09، 95٪ CI ، 0.02-0.47) أو العيش مع كفيل (AOR: 0.28، 95٪ CI، - 0.08 0.95) كانت أقل عرضة للإبلاغ عن مستويات أعلى من النشاط البدني. في انخفاض مستويات النشاط البدني هي مشكلة صحية عامة كبيرة بين المهاجرين وخاصة في جنوب آسيا والعرب من الإناث والعاملين كسائق ، في المكاتب ومراقبي المتاجر مع عواقب على الأمراض غير السارية.

مفاهيم البحث الرئيسية: النشاط البدني، المهاجرون، الإمارات العربية المتحدة.

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Special thanks go to my parents, husband, and sister who helped me along the way. I am sure they suspected it was endless.

Dedication

To my beloved parents and family

Table of Contents

List of Tables

List of Figures

List of Abbreviations

ACSM	American College of Sport Medicine
BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
CHD	Coronary Heart Disease
CVD	Cardiovascular Disease
DM	Diabetes Mellitus
HBA1C	Hemoglobin A1c
HDL	High-Density Lipoprotein
HR	Heart Rate
IHD	Ischemic Heart Disease
IPAQ	International Physical Activity
IQR	Interquartile Range
LDL	Low-Density Lipoprotein
MET	Metabolic Equivalent of Task
MVPA	Moderate- to Vigorous-Intensity Physical Activity
NCD	Non-Communicable Disease
NHANES	National Health and Nutrition Examination Survey
OD	Odd Ratio
PR	Prevalence Ratio
RR	Relative Risk
SD	Standard Deviation
STEPS	The WHO STEP Wise Approach to Surveillance

UAE	United Arab Emirates
VO^2 Max	Maximal Oxygen Uptake
WC	Waist Circumference
WHO	World Health Organization

Chapter 1: Introduction

1.1 Overview

Globally, 31.1% of adults are inactive [1]. Inactivity is highly related to obesity and non-communicable diseases. Evidence strongly supports an inverse association between all-cause mortality and physical activity [2]. A high prevalence of obesity and related cardio-metabolic disorders has been reported in the united Arab Emirates (UAE). There was a 2-3-fold increase in overweight and obesity prevalence between 1989 and 2017 [3]. Furthermore, prevalence of obesity and associated non-communicable diseases (NCDs) are extremely high in the UAE expatriates [4].

Gulf countries witness high waves of migration from different countries around the world. Foreigners constitute around two thirds of residents in UAE. Furthermore, migrants occupy 98% of the private sector jobs. UAE foster large construction and investment projects, which necessitate workers. Other work categories include of cleaning services, salesmen, and domestic service. A major source of migrants to UAE is South Asian population [5].

South Asian people have a higher prevalence and incidence of CVD, have twice the burden of diabetes and have a different cardiovascular risk profile [6]. Little is known of the physical activity behavior of South Asian Indian immigrants (SAIs), though they have more than twice the risk for cardiovascular disease (CVD) and diabetes [7]. Migrants from south Asians origin in UK reported to have a higher risk for coronary heart disease (CHD) and diabetes when compared with the Europeans. Explanation may be related to obesity, lipids and insulin resistance, which all may be significantly prevented by physical activity. Physical activity levels of south Asian has been reported as low compared to Europeans [8]–[12]. Migrants account for 80% of

the total population of United Arab Emirates. Few data were available on physical level among migrant population of UAE. This study aimed to bridge this gap.

United Arab Emirates has massive development over the last decades. It changed from a developing country to a modern and wealthy country with a Western lifestyle. This economic growth had a positive social and health outcome, including increasing life expectancy. Conversely, rapid development and urbanization have supported a significant problem of chronic diseases, particularly obesity-related cardiovascular risk [13]. The United Arab Emirates (UAE) population consists of a multinational residents with diverse educational backgrounds, religious beliefs, and cultural norms. Natural growth and migration result in the formation of UAE demographics and population growth. UAE has witnessed fast-paced economic and industrial developments which mandated the recruitment of migrant workers from all over the world to fulfil the manpower demands. Therefore, the population growth over the past four decades has been mainly due to the high inward migration. This has formed a unique population structure. Expatriates account for 80% of the UAE population. Among immigrants, the ratio of males to females is 3.7:1. This imbalance is due to high male immigrant employment in construction compared with migrant females working in hospitality, health care, or domestic service. Looking further to the distribution of migrant workers by nationality; construction labors and manual workers tend to be from the Indian subcontinent; middle managers and health care workers from the Philippines, India, and neighboring Arab countries [14].

Countries experiencing large waves of immigration in its history attempt to understand the health status and needs of immigrants because of their growing numbers and their contribution to the health of the nation. This task is challenging mainly because of the heterogeneity of immigrant populations, and uncertainty about

how migration affects health [15]. Some studies have shown that immigrants enjoy superior health compared to the health of host society. As immigrants adopt the host society health behaviors over time, their health status begins to converge with that of the developed country (16, 17). Moreover, Ethnicity of migrants in the host country is poorly measured in epidemiological studies. When aimed to understand physical activity in ethnic groups, the influence of other factors related to ethnic background may be missed [18].

1.2 Statement of the problem

The increasing prevalence of physical inactivity threatens the health of communities, placing them at much greater risk for development and early onset of a wide variety of chronic diseases and health conditions. Studies in UAE migrant's population reported high prevalence of non-communicable diseases (hypertension, diabetes and obesity) in migrant population in UAE [19]–[21]. Furthermore, minimal data is available on the prevalence of insufficient physical activity and its effect on various health outcomes in the UAE migrant population.

Objectives

- Determine the prevalence physical inactivity and its correlates among immigrants residing in the UAE.
- Explore how physical activity varies between and within different ethnic groups in the UAE.
- Assess the association between Physical activity and selected health outcomes in immigrants residing in the UAE.

1.3 Relevant literature

Physical activity definition

Physical activity (PA) is defined as any kind of bodily movement produced by skeletal muscles that requires energy expenditure. Energy expenditure is mainly quantified by kilocalorie (Kcal). PA can be any activity that involves playing, working, transportation, household activities and recreational activities. PA can be categorized based on portion of time in which PA happens. It mainly divides activity portions to work, home, sleeping and leisure. Components of PA include frequency, intensity, duration, and type of activity [22], [23].

Physical activity recommendation

Regular physical activity has health benefits for everyone, regardless of age, sex, race, ethnicity, or body size. Physical Activity Guidelines provide data pertaining types and amounts of physical activity that have health benefits for multiple population groups. Benefits of physical activity on health include better functioning, sleep, development and cardiovascular prevention. Adults should accumulate at least 150-300 minutes a week of moderate-intensity, or 75-150 minutes a week of vigorous-intensity aerobic physical activity, or combination of both. Exercise should include balance training, aerobic and muscle-strengthening exercise [24].

Physical activity has several positive clinical outcomes and considered as integral component of the prevention and treatment of chronic disease. Physical activity prescription by doctors has a therapeutic potential in primary, secondary and tertiary prevention of chronic disease. physicians recommendations might impact patient engagement in physical activity [25].

The Centers for Disease Control and Prevention (CDC), and the American College of Sports Medicine (ACSM) recommend a minimum of 30 minutes of moderate activity on most days of the week. This recommendations which included types and amounts of physical activity are identified for healthy adults in order to improve and maintain health [26]. More specifically in order to promote and retain wellbeing, all healthy adults are required to perform moderate-intensity aerobic (endurance) physical activity for at least 30 min on five days each week or vigorous-intensity physical activity for a least of 20 min on three days each week. The recommendation can be achieved through a mixture of moderate- and vigorous-intensity activity. The dose-response relation between physical activity and health, allow for more improvement in personal fitness, reduction in chronic diseases risks and disabilities and avoidance unhealthy weight gain [27].

Different methods of physical activity measurement

The main role of assessing physical activity incorporates frequency, duration, intensity and types of behaviours. Physical activity measurements include subjective measures and objective techniques that tackle different body movement. Subjective measures include self-reported questionnaire, diaries and logs. Objective measures are direct which include motion and multiple sensors. It mainly rely on incorporation of accelerometers, pedometers, heartrate monitors [28].

Many different methods have been used to assess physical activity. These methods measure physical activity based on seven key categories: job classification, calorimetry, survey procedures, physiological markers, behavioural observation, mechanical and electronic monitors, and dietary measures. The criteria of being valid, reliable and practical vary according to the method used and no single method is

considered to fulfil the criteria. Priced instruments are normally impractical for application purposes. For large scale studies its practical to employ survey's as employing objective monitoring which included heart monitoring, movement sensors and doubly labelled water procedures is still experimental and costly. Strong association has been identified between physical activity and health despite the difficulty faced in measurement and quantification [22].

The accurate measurement of PA is essential to gain an in depth understanding of PA-related disorders. Furthermore accurate measurement can prove the dose-response relationship that exists between volume, duration, intensity and pattern and the concomitant health benefits. Varieties of methods are available for physical activity measurement. Validity, reliability and sensitivity as well as feasibility and practicality of measure are to be considered when selecting measurement techniques. Validity is guaranteeing that the test is measuring what is intended to be measured. It normally involves comparison of the proposed measure against a comparable measure. Generally the measure is validated against the gold standard measure. An accurate examination of physical activity happens when there is a good agreement between gold standard and the proposed method. On the other hand reliability refers to consistency of the result the test can produce on different occasions. Some other factors should be considered in choosing PA measurement method and analysing results yielded from these methods. The main determinant of this selection is feasibility. It determines Possibility based on the number of participants, the setting of the study and the cost. For instance assessment of PA by monitors can't be feasible in epidemiological studies with large population number. When choosing methods of PA measurements reactivity where people may change their behaviours once it's observed should be considered.

Another factor to be carefully considered is over-reporting of PA while using self-reported methods as an act of social desirability in order to fulfil the intervention goal [29].

There are special considerations that need to be integrated when choosing a tool for physical activity measurement. A special attention should be paid to the purpose of assessing physical activity, literacy requirements of a tool, the duration of the recall, the documented validity of the tool and the population being studied. Furthermore the generalizability needs to be considered as well. Questionnaires are popular tools for measuring physical activity. It mainly includes Surveys interviews and diaries. It's a cheap method with application in large population. Questionnaires can be utilized adequately for physical assessment measurement. Short questionnaires unexpectedly yielded a good result in measuring and quantifying physical activity [30], [31].

A cross sectional study was done in 2 villages of south India (Andhra Pradesh state and Bangalore city) to validate physical activity level derived from 24 h activity diary and accelerometer against the heart rate oxygen consumption. It included 94 participants. The study concluded that questionnaire has sensible validity which has been well documented in epidemiological studies. Furthermore, questionnaires showed a reasonable validity when applied to a group with variety in physical activity levels [28].

Importance of physical activity

Physical activity can influence multiples tissues, organs, and systems, and leads to complex multisystem responses that improve health outcomes [32]. Physical

activity represents an important indicator of health. It leads to a major risk reduction in non-communicable diseases. A reverse causation was established between low level of PA and many serious diseases as well as mortality [33]. PA is known for its importance in prevention of non-communicable diseases in many diverse populations. Furthermore, it is well documented that PA reduce premature death and cancer. Physical inactivity and unhealthy diets are responsible for the overweight and obesity epidemic. Physical inactivity accounts for 6% of deaths worldwide. Globally, physical inactivity is considered as the 4th leading risk factor for death [34].

Development and mechanization, has a major impact on physical activity patterns. It mainly promoted automation in different domains of daily life, resulting in the lowest physical activity in human history [35], [36]. Participation in PA has been associated with lower risk of death as well as positive results in reducing morbidity and mortality [26], [37]. Despite the known association between PA and health benefits specialty metabolic and obesity effects, PA remains underused as intervention to fight CVD, all-cause mortality, and other outcomes [38].

Physical activity and mortality

Evidence strongly supports an inverse association between physical activity and all-cause mortality. Active individuals have 30% reduced risk of all-cause mortality [2]. A dose response relationship was reported between sitting time and premature death [2].

A recent meta-analysis of prospective studies was performed investigating the association between PA and risk of all-cause, CVD, and cancer mortality [39]. The analyses included 1,809,912 participants for all-cause mortality, 2,101,701 participants for CVD, and 1,180,914 participants for cancer outcomes. The main

finding of the study was a curvilinear relationship between PA and all outcomes, with highest relative benefits observed between inactivity and low volumes of PA. For instance, performing less than recommended amounts of PA was associated with 11% lower all-cause mortality (RR, 0.89 (95% CI: 0.84-0.94)) in men and 17% lower all-cause mortality (RR, 0.83 (95% CI: 0.75-0.92)) in women, comapred with inactive participants. The corresponding relative risks for CVD mortality were 0.87 (95% CI: 0.80-0.94) for men and 0.71 (95% CI: 0.57-0.88) for women.

In an analysis of pooled data from 6 studies in the National Cancer Institute Cohort Consortium involving 661,137 men and women with a median follow-up of 14.2 years, less than the recommended minimum of 7.5 metabolic equivalent hours per week was associated with a 20% lower mortality (HR, 0.80 (95% CI: 0.78-0.82)) compared with those who were inactive. Interestingly, the authors observed an upper threshold for mortality benefit at 3 to 5 times the PA recommendations (HR, 0.61 (95% CI: 0.59-0.62)). The dose-response association of PA with mortality was also observed for cardiovascular and cancer mortality and both moderate and vigorous intensity PA was associated with longevity benefits [40].

A national observational study of U.S. Health and Nutrition Examination Survey (NHANES) with sample of 4510 was done with follow up study of 6.6 years. Participant's age was 40 years and above whom enrolled in 2003 to 2006 with a follow up till 2011. It mainly evaluated the association of objectively measured PA using hip worn accelerometer and all-cause mortality. Participants were classified into classes of PA. For average counts/minutes of PA, active classes had a lower risk of mortality. Higher PA level or duration predicted a lower mortality risk [41].

A mortality analysis of NHANES 2003-2004 cycles which included 1677 participants aged 50 years and above with a follow-up till December 31, 2006 investigated relationship between sedentary behavior and mortality as well as explored the enhancement role of PA in this relationship. The PA data was measured using accelerometer. Sedentary time more than 8.60 hours/day was associated with increased risk of mortality (RR, 2.03 (95% CI: 1.09-3.81)). Low to moderate PA level less than 606 min/day was associated with increased all-cause mortality (RR, 3.30 (95% CI: 1.33-8.17)) [42].

Another study utilized 5562 adults from NHANES to explore association between different levels of objectively measure PA and mortality. Study follow up was 6.7 years. Low PA and moderate to vigorous (MV) PA was assessed using accelerometer and classified into quintiles. Women with low PA had mortality hazard ratio of 0.58 (95% CI: 0.38-0.88), while women with MVPA had mortality hazard ratio of 0.34 (95% CI: 0.20-0.57). Equivalent HRs of mortality were observed in men: HR, 1.02 (95% CI: 0.64-1.61) and HR, 0.39 (95% CI: 0.27-0.56) respectively. The study concluded that MVPA was significantly associated with lower mortality risk. Women with low PA have substantially reduced mortality risk compared to male [43].

Mortality risk was assessed in study utilizing sample of 3029 participants aged 50 to 79 from NHANES, 2003-2006. The study mainly examined role of objectively measured light, moderate, vigorous and total PA in prediction of mortality risk. It also looked into substituting sedentary time with light or moderate to vigorous PA. Participants in the higher tertiles of total PA count had a reduced risk of mortality compared to lower tertiles, adjusted HR, 0.21 (95% CI: 0.12-0.38). In addition, participant in the middle tertiles had a reduced mortality risk: HR, 0.36 (95% CI: 0.30-

0.44). Furthermore, substituting sedentary time (30 min) with light PA resulted in reduction in mortality: HR, 0.49 (95% CI: 0.25-0.97). The conclusion was that a higher volume of PA regardless of intensity is related to lower mortality. Replacing sedentary time with light PA reduced mortality risk and replacing it with MVPA further reduced mortality [44].

Another study explored the effect of both MVPA and sedentary time in all-cause mortality. The study linked mortality data from national death index with 2003–2006 NHANES. The study included 5575 U.S. adults with a mean age of 50 years. Follow up period was 81 months. The study reported that MVPA and sedentary time were associated with all-cause mortality. The study concluded that 1 min increase in MVPA was associated with reduction in all-cause mortality (HR, 0.98; 95% CI: 0.96-0.99). Furthermore, sedentary time was also associated with all-cause mortality (HR, 1.001; 95% CI: 1.0003-1.002). The conclusion of the study was that positive effect of MVPA was mitigated by prolonged amounts of time spent sedentary [45].

A data analysis of 6.6 years follow up from NHANES (2003-2006) was done in a sample of U.S. adults 40 years and older (n=4840) to assess the extent to which accumulated MVPA either total or in bouts can reduce mortality. The study examined mortality associations by quartiles for 3 MVPA measures: total, ≥5 minute, or ≥10 minute bouts. The study provided evidence that PA reduces the risk of mortality regardless of the how it was performed. Hazard ratios for total MVPA was 0.27 (95% CI: 0.16-0.45), 0.28 (95% CI: 0.17-0.45) for 5 minutes bout, and 0.35 (95% CI: 0.23-0.53) for a bout lasting ≥10 minutes [46].

Data from the 1999–2006 NHANES were utilized including follow-up through 2011. The study aim was to demonstrate the association between MVPA and survival benefits. PA such as swimming, running, cycling, etc., were assessed as well as MVPA (METs) were measured. Cardiovascular risk was assessed using biomarkers including cholesterol, HDL and C-reactive protein (CRP). Six level dose–response PA categories were created, 2000 MVPA MET-min-month which is reference group representing the current MVPA guidelines, 2000-3999 MVPA MET-min-month, 4000-5999 MVPA MET- min-month, 6000-7999 MVPA MET-min-month, 8000-9999 MVPA MET-min-month; and 10,000+ MVPA MET-min-month. When compared to reference group, a dose-response association was found between MVPA and mortality. Unadjusted HR for MVPA categories were 0.57 (0.46-0.70), 0.53 (0.39-0.73), 0.52 (0.39-0.70), 0.43 (0.26-0.71) and 0.39 (0.30-0.52) respectively, with 2000 MVPA MET-min-month as reference. After adjustment, the dose response relationship was also observed with MVPA HRs as follow 0.69, 0.65, 0.59, 0.61 and 0.55, respectively). Those engaged in the uppermost MPVA which is 5 times the recommendation had the lowermost HR, and 45% reduction in mortality risk (HR, 0.55; 95% CI: 0.41-0.74). The study concluded that greater MVPA was associated with favorable cardiovascular profile. Additionally, PA was associated with cardiovascular biomarkers across gender [47].

The Northern Manhattan Study which is multi-ethnic population based was conducted to assess impact of different risk factors in vascular diseases incidence among a stroke free cohort. It focused on healthy lifestyle that is associated with health benefits like: reduction in incident coronary heart disease and stroke. The primary exposure was leisure time (LT) PA and the outcome was mortality (total, vascular,

non-vascular). Data was collected about the risk factors including hypertension, diabetes, height, weight, and fasting glucose and lipid panels and smoking. PA was measured using questionnaire that highlights duration and frequency of leisure-time activities for the past 2 weeks. Participants (n=3298) with a mean age of 69 years were followed up on annual basis for up to 11.8 years for any medical conditions including new cardiac or neurologic symptoms, hospitalizations, or death. Overall, any PA was found to be protective against all-cause mortality and non-vascular mortality: HR 0.84 (95% CI: 0.75-0.94) but not vascular diseases. However, the protective effect against vascular disease was reported only in non-obese participants. An interaction ($P < 0.05$) was found between body mass index (BMI) less than 30 and mortality. LTPA was associated with reduction in all-cause mortality (HR, 0.77; 95% CI: 0.68-0.87), and vascular mortality (HR, 0.79; 95% CI: 0.65-0.97) among participant with BMI less than 30 [48].

The Veterans Exercise Testing Study (VETS) study is a prospective ongoing longitudinal study that started in 1983. The study aims to discover lifestyle factors effect in adverse health outcome development. Study participants were 8171 male veterans who had baseline cardiorespiratory fitness measurements and self-reported PA, and were followed up for an average 8.7 years. Primary outcome was all-cause mortality. Findings indicated that PA is a strong predictor of mortality after adjustment for clinical variables [49].

A pooled analysis of nine prospective cohort studies consisting of 467,729 East Asian individual was performed to evaluate the association between leisure-time physical activity (LTPA) and mortality risk. An inverse relation was reported between quantity of LTPA and all-cause mortality, and cause specific mortality compared to

individuals who reported less than 1 hour of LTPA/week (P <0.001). Comparing low versus high LTPA, an inverse association was observed between total mortality among individuals with severe or life-threatening diseases including cardiovascular disease, cancer and stroke HR 0.81 (95% CI: 0.73-0.89) and among individuals with chronic diseases like hypertension and diabetes HR 0.86 (95% CI: 0.80-0.93) [50].

A study was done on 17,708 women from 2011 to 2015. Physical activity was assessed using accelerometer to explore association of objectively measured total physical activity, light physical activity, moderate to vigorous physical activity and sedentary behavior with mortality. The average follow up time was 2.3 years. Total physical activity and moderate to vigorous physical activity both had an inverse association with mortality (P=0.002), (P=0.0002) respectively. HR for Total physical Activity ranged from 0.35 to 0.79 for categories and 0.28 to 0.61 for MVPA Categories. There were no associations of LPA or sedentary behavior with mortality [51].

A longitudinal cohort study of Swedish population with 15 years follow up period was done to explore associations of different objectively measured physical activity patterns with all-cause mortality particularity cardiovascular disease and cancer. Physical activity patterns included total physical activity, moderate to vigorous physical activity, light physical activity and sedentary time. Participants included 851 persons both gender ≥35 years. The study finding reported a strong inverse relationship between moderate and vigorous physical activity and mortality. Additionally in enhanced understanding of the relationship between light physical activity and sedentary time and mortality leading to survival benefits. Physical activity was categorized into tertiles. Individuals in the utmost sedentary tertiles had an increased

risk of all-cause mortality hazard ratio 2.7 (95% CI: 1.4-5.3), cancer mortality HR 4.3 (95% CI: 1.2-16), and CVD mortality HR: 5.5 (95% CI: 1.4-21.2). For all-cause mortality comparing participants in the highest light intensity group with lowest group HR was 0.34 (95% CI: 0.17-067). A similar pattern was found with CVD Mortality and cancer. 90% reduction in CVD mortality risk was found in participant with most time in MVPA, so more time spent in MVPA was associated with major reduction in CVD Mortality. More time spent in MVPA was associated with the largest risk reduction for CVD mortality, with an almost 90% lower risk in the tertiles with the most time in MVPA [52].

A cohort EPIC study of 334,161 European men and women (age between 25-70 years) with a mean follow up time of 12.4 years investigated mortality risk from adiposity and how it's attenuated by physical activity. The main aim of the study was to examine the combined association between PA and obesity with mortality as physical activity influence mortality indirectly through reduction in adiposity mainly waist circumference regardless change in body weight. Furthermore, the study explored the years of life gained for physical activity exposure. Outcome measures included height, weight, waist circumference and physical activity using validated self-report instrument. Results concluded significant interactions between physical activity, BMI and waist circumference. Overall, the study reported an inverse association between physical activity and all-cause mortality at all levels of BMI and waist circumference. Hazards of mortality estimated within BMI and WC strata. All-cause mortality hazards were decreased by 16-30% in moderately inactive participants compared to inactive participants. Hypothetically, elimination of inactivity and high waist circumference reduce death by 7.35% (95% CI: 5.88-8.83) while for obesity it

was 3.66% (95% CI: 2.30-5.01). in conclusion a small increase in physical activity is reported to be beneficial [53].

Leisure time physical activity is known to have health and life expectancy benefits. A prospective cohort study in Taiwan population consisting of 416,175 participants (199,265 men and 216,910 women) was conducted to assess the health benefits of leisure time physical activity using a self-administered questionnaire; Moreover, it investigated the mortality and life expectancy, if physical activity was not sufficiently practiced as per guidelines. The study was done between 1996 and 2008 as a standard medical screening program in Taiwan with an average follow up period of 8.05 years. The physical activity was measured using self-administered questionnaire. Physical activity categories were defined as low, medium, high, or very high activity. Results indicated that mortality risks, all-cause mortality and all-cancer mortality increased in the inactive group. It showed that daily average 15 min of physical activity lead to significant health benefits. Exercising for 15 min per day led to 14% reduction in risk of all-cause mortality (95% CI: 0.81-0.91) or years gained life expectancy. Subsequent additional of 15 min of daily exercise on top of the minimum of 15 min resulted in 4% reduction in all-cause mortality (95% CI: 2.5-7.0) and 1% (95% CI: 0.3-4.5) reduction in all-cancer mortality. Inactive individuals had a HR 1.17 (95% CI: 1.10-1.24) increased risk of mortality when compared to individuals in the low volume groups [54].

Association of running as a leisure time physical activity and all-cause mortality and cardiovascular mortality was examined in prospective observational study of 55,137 adults 18-100 years old with a follow up time of 15 years. Running was included in a medical history questionnaire by leisure-time activity. Nearly 24%

of the participants were running. Results showed that runners had 30% reduced all-cause Mortality and 45% cardiovascular mortality when comparing them with non-runners. Furthermore, slower speeds and lower doses were also associated with lower morality. Finally continuous running was strongly associated with decreased all-cause mortality 29% and 50% CVD Mortality. Running was classified into quintiles based on weekly time. All quantiles had a similar trend of reduced All-cause mortality risk, for <60 min HR, 0.73 (95% CI: 0.61-0.86), 60 to 119 min HR, 0.65 (95% CI: 0.56-0.75), 120-179 min HR, 0.71 (95% CI: 0.59-0.86), and 180 min HR, 0.76 (95% CI: 0.63-0.92). Furthermore CVD Mortality HR was 0.46 (95% CI: 0.33-0.65), 0.56 (95% CI: 0.43-0.73), 0.54 (95% CI: 0.38-0.77), and 0.65 (95% CI: 0.46-0.92), respectively [55].

A prospective twin cohort study was done to investigate association between physical activity and fitness and premature mortality, especially focusing on genetic factors which may play a role in the association. As baseline data in the study all participant which included 7925 healthy men and 7977 healthy women derived from the finish cohort. Their ages ranged from 25-64. Participants responded to physical activity questionnaire habits and acknowledged predictors of mortality. Participants were classified as exercisers, occasionally exercisers and sedentary. The main outcome measure was all-cause mortality and discordant deaths among same-sex twin pairs from 1977 through 1994. Regarding physical activity result concluded that majority were occasional exercisers, 15% were sedentary, and 55% of men and 38% of women participated in vigorous activity. Occasional Exercisers and conditioning exercisers had reduced hazards of death when compared with sedentary. Leisure-time physical activity was found to reduce mortality, even after genetic and other familial

factors are taken in consideration. The benefits of PA remained even after controlling for all predictors of mortality. Adjusted hazard ratio for death in occasional exercisers was 0.71 (95% CI: 0.62-0.81) and for conditional exercisers was 0.57 (95% CI: 0.45-0.74) compared with sedentary individuals (P=0.001). After genetic and familial adjustment among twin pairs occasional exercisers had OD, 0.66 (95% CI: 0.46-0.94 and conditional runners OD was 0.44 (95% CI: 0.23-0.83) (P=0.005) [56].

The Nurses' Health Study is a large prospective cohort study which was established between 1979 till 1996. It included 121,701 female registered nurses aged 30 to 55 years who responded to a mailed questionnaire. The study mainly explored association between recreational physical activity and mortality. The study took in consideration the effect of recreational physical activity as well as walking and vigorous physical activity. The study concluded physically active women tend to be having reduced mortality risk compared to less active women. Each level of physical activity was inversely associated with mortality risk with 20-30% reduction in risk. Cardiovascular mortality showed a stronger inverse association than cancer mortality. Adjusted RR for levels of physical activity ranged between 0.82 (95% CI: 0.76-0.89) for 1-1.9 hour per week and 0.71 (95% CI: 0.61-0.82) for > or equal 7 hour per week [33].

Physical activity and heart health

Cardiovascular diseases include all diseases that affect either the heart or blood vessels which mainly include: angina, atherosclerosis, coronary heart diseases, myocardial ischemia or acute coronary syndrome, hypertension, cardiomyopathies and heart failure. Physical inactivity increases the prevalence of cardiovascular diseases. Regardless of obesity, physical activity is predictor of lower cardiovascular risk.

Physical activity exerts its cardiovascular effect through central nervous system regulation, enhanced baro-reflux function and vagal tone and endothelial function. Effects of physical inactivity and coronary vascular disease is highly individualized. Physical activity positive effect can be explained by antioxidant and nitric oxide effects, suppressed inflammation and cytokines release and improvement of endothelial regeneration. Physical activity causes reduction in both systolic and diastolic blood pressure. There is a dose-response association between physical activity intensity and blood pressure following an exercise [2].

Physical inactivity is considered as independent risk factor for coronary heart disease, whereas physical activity is an effective prevention measure against coronary heart disease through proper conservation of endothelial function, coronary vascular remodeling, blood flow enhancement, vascular alteration improvements and formation of collateral circulation. In addition to primary disease prevention exercise lessen the secondary development of disease [57]. The epidemic of non- communicable diseases specifically cardiovascular disease immerses the Western world. Physical activity regardless of intensity is an efficient way to sustain heart health and cardiovascular fitness [58]. All factors in determining cardiovascular risks such as smoking, lipids, blood glucose, blood pressure, and diet go through physical activity. Physical activity attenuates the cardiovascular disease risk associated with obesity through better cardiac structure and function. Association of obesity with cardiovascular disease risk may be partly related to physical inactivity [38], [59].

Chronic diseases are major health risk. Physical inactivity is a primary cause for most of the chronic diseases and a damaging factor of health and normal organ functions.[2]. Physical activity in adjunct with lifestyle changes can prevent mortality

due to cardiovascular diseases. Physical activity plays a major role in the primary and secondary prevention of cardiovascular diseases. There is an inverse dose-response relationship between physical activity and cardiovascular disease and mortality risk. Physical inactivity is considered to be the fourth risk factor leading to non-communicable diseases mainly cardiovascular diseases. Worldwide the prevalence of physical inactivity is still high which result in 10% of premature death related to non-communicable diseases. Deceasing sedentary behaviors but not meeting guidelines is also known to reduce mortality [60].

Lack of physical activity is associated to nearly 35 unhealthy conditions. Furthermore, it lowers the age for onset of chronic diseases. Physically inactive individuals have 45% more cardiovascular diseases compared to active individuals, especially type 2 Diabetes. Physical inactivity can be translated into less healthy coronary risk profile and major predictor of BMI and abdominal obesity. Principally aerobic fitness reduced mortality for several clinical conditions including cardiovascular disease, hypertension, type 2 diabetes breast and colon cancer, osteoporosis and stroke [61].

A systematic review and meta-analysis of 27 experimental and 45 observational studies was done in order to explore association between physical activity specialty and cardio metabolic health with mortality. The review showed that overall light physical activity has a major impact on cardio metabolic health and mortality risk. Experimental studies results revealed that frequent and short bouts of physical activity decreased insulin by 25.1% (95% CI: 31.8-18.3) and postprandial glucose by 17.5% (95% CI: 26.2-8.7). Most prospective observational studies results

showed that the mortality risk was reduced by more time spent in daily light physical activity HR, 0.71 (95% CI: 0.62-0.83) [62].

A prospective cohort study was done recruiting participant age 35 to 71 years from 17 different countries including UAE to explore the protective role of physical activity against cardiovascular diseases. Comparing countries at different economic level, the association between subjective physical activity amount and type and mortality and cardiovascular risk was examined. Cardiovascular diseases and mortality were traced for 6.9 years. Non recreational and recreational physical activity was associated with health benefits. For countries regardless of the economic status, higher physical activity level regardless of type is associated with lower mortality and cardiovascular diseases. Reduction in mortality was reported with Moderate physical activity HR, 0.80 (95% CI: 0.74-0.87) and high physical activity HR, 0.65 (95% CI: 0.60-0.71) (P <0·0001 for trend). Furthermore, physical activity was associated with reduction in major CVD HR, 0.86 (95% CI: 0.86, 0.78-0.93) [63].

Data analysis was done for data from National Health and Nutrition Examination Survey (NHANES) which included 2421 participants' age 40-79 years. The analysis mainly examined the relationship between activity patterns and the first atherosclerotic cardiovascular diseases. The participants had an objective physical activity measurement using accelerometer. Physical activity patterns of participants were classified into four groups based on their PA, light PA and sedentary behavior. Active Participants had a lower risk score for first atherosclerotic cardiovascular disease. Active participants in group 1 (most active) and 2 (active) had reduced atherosclerotic cardiovascular events (OR=0.34; P=0.001) and (OR=0.23; P=0.001)

respectively. The study concluded that participants who have lower movement patterns had more risk score for cardiovascular and atherosclerotic diseases [64].

A meta-analysis of prospective cohort studies examined the quantifiable dose–response association between PA and Heart failure risk. The meta-analysis confirmed an inverse dose–response relationship between physical activity and risk of heart failure HR, 0.70 (95% CI: 0.67-0.73). Modest decrease in HF risk was reported when comparing no leisure time physical activity with people meeting recommended guidelines HR, 0.90 (95% CI: 0.87-0.92). A significant risk reduction was reported with twice and 4 times engagement in minimum recommended guidelines HR, 0.81 (95% CI: 0.77-0.86) and 0.65 (95% CI: 0.58-0.73) [65].

A national cohort study of male military enrolls consisting of 1,547,407 participants in Sweden with age 18 and above. The study aim was to examine in large national cohort the interactive effects of obesity mainly BMI, aerobic fitness, and muscular strength in late adolescence on risk of IHD in adulthood. Although, physical inactivity and obesity are known risk factor for ischemic heart diseases, the interactive role of them is not yet well understood. The studies concluded that higher BMI and low Aerobic fitness was associated with higher risks of ischemic heart disease. Higher risk of IHD was associated with high BMI or low aerobic fitness. Combination of both high BMI and Low Aerobic Fitness has been reported to be associated with the highest IHD Incidence Ratio 3.11 (95% CI: 2.91-3.31). Furthermore poor aerobic fitness was a strong risk factor even within participants with normal BMI [66].

Harvard alumni cohort study in which self-reported physical activity was measured in men age 39 to 88 to determine the intensity and quantity required for

prevention of coronary artery diseases and other risk factors. The study showed that there is a strong inverse association between total physical activity and vigorous physical activity with strongest reduction in coronary heart disease risk. Physical activity was measured in kilojoules per week, men expending 2100 to 4199, 4200 to 8399, 8400 to 12,599 and more than 12,600 kJ/week had RR of 0.90, 0.81, 0.80, and 0.81, respectively (P=0.003). Overall, physical activity showed favorable effects on coronary heart diseases [67].

A systematic review and meta-analysis looked into association between sedentary time and diabetes, cardiovascular disease and mortality. The review concluded that greater sedentary time was associated with increase in diabetes risk 112% increase, RR, 2.12 (95% CI: 1.61-2.78), cardiovascular mortality increase of 90 %, HR, 1.90 (95% CI: 1.36-2.66) and all-cause mortality HR, 1.49 (95% CI: 1.14-2.03). Relationship is most consistent for the risk of diabetes [68].

A standardized case-control study was conducted to explore associates of myocardial infarction in 52 countries (262 Centers) across north and South America, Australia, Europe, Asia and Middle East. Cases were 15,152 versus 14,820 controls. Risk factors included physical inactivity, diet, abdominal obesity hypertension, diabetes, smoking, alcohol consumption, psychosocial factors and blood lipids. Risk factors of myocardial infarction were concluded as physical inactivity, abdominal obesity, abnormal blood lipids, dietary factors (consumption of fruits and vegetables), smoking and alcohol consumption. Study finding concluded that all the risk factors were associated with Myocardial infarction worldwide across both genders. Diabetes OR 2.37, population attributable risk 9.9%, hypertension OR 1.91, population attributable risk is 17.9%, abdominal obesity OR 1.12, regular physical activity OR

0·86, population attributable risk 12.2%, were all considerably associated with acute myocardial infarction (P <0·0001) [69].

A prospective 17.7 years follow-up Finnish study was done in 22,528 men and 24,684 women aged between 25 and 64 years. It mainly aimed to explore effects of body mass index and physical activity separately and combined with cardiovascular disease and cancer mortality. Measurement of physical activity, smoking, demographics, socioeconomic factors and health history was done using a self-administered questionnaire coupled with measured height, weight, blood pressure, and serum cholesterol. Obesity / BMI were significantly related to risk of cardiovascular and total mortality. Physically active participants had significantly lower age-adjusted mortality from cardiovascular, cancer and all causes compared with sedentary participants [70].

Physical activity and hypertension

Hypertension is cardiovascular disease that may have both genetic and environmental risk factors. Physical inactivity is a lifestyle factor that has major impact on the incidence of hypertension and its risk factors. Physical activity is well documented for its hypertension reduction effect through increases in cardiac stroke volume and heart rate which in turn raise cardiac output [71], [72].

CARDIA which is a longitudinal 15 years follow-up study was done to explore association between physical activity and hypertension. The study investigated the risk factors of coronary heart disease in young adults. Participants were young adults aged 12-30 who were randomly selected from multiple centers in USA. Blood pressure was measured in the six examination periods including baseline and at 15 years follow up. Physical activity was assessed using the assessor administered CARDIA questionnaire

that included 13 categories of physical activity during 12 months which focused on different types of activities including vigorous and moderate intensity physical activity. Results confirmed a significant inverse association between physical activity and hypertension in young adults. More active participants had a reduced HR of hypertension (HR, 0.83 (95% CI: 0.73-0.93)) [73].

Physical activity and diabetes

Physical activity and adiposity contribute directly to insulin sensitivity. Physical activity which results in depletion of glycogen stores promotes increased insulin sensitivity. Conversely, physical inactivity leads to inactive skeletal muscles and low ATP demand, which will lead to high glycogen and low glucose demand and thus insulin sensitivity decreases [61]. Metabolic syndrome includes a cluster of three out of five risk factors of type 2 diabetes and cardiovascular diseases. Five risk factors include high triglycerides, Cholesterol, hypertension, impaired fasting glucose, and high waist circumference. Sedentary behavior and physical inactivity is a primary cause of metabolic syndrome, which affect all risk factors associated with metabolic syndrome. A primary prevention of metabolic syndrome includes physical activity. Obesity is defined by BMI. Waist circumference is also considered when defining obesity, as it's an indicator for intra-abdominal adiposity. Inactivity fosters obese co-morbidities include conditions that increase with physical inactivity like: type 2 diabetes, cardiovascular diseases including coronary heart disease, dyslipidemia and cancers. Insulin resistance and impaired glycemic panel lead to development of type 2 diabetes and increase cardiovascular events. Macro vascular conditions can be reversible by PA; however, micro vascular damage in type 2 diabetes is non-repairable by physical activity. Physical activity can improve type 2 diabetes without weight loss

as it affects glucose sensitivity and endothelial metabolism. It also decreases fat to lean mass ratio as well as visceral adiposity. Even low physical activity has a favorable effects on plasma glucose and tolerance tests [2].

A quasi- experimental study was done to investigate role of regular physical activity in the diabetes mellitus patient health. The study aimed to investigate the effect of exercise on biological indicators such as hemoglobin A1C (HbA1c), body mass index (BMI) and VO^2max of patient with diabetes mellitus. The study included patients between 33-69 years old who attended a long-term exercise training program. The study concluded that long term regular physical exercise improved the glycemic index, cardiovascular fitness and body composition. The effect of the physical activity program for outcome variables was BMI ($F=17.15$, $P<0.05$), HbA1c ($F=11.08$, $P<0.05$), and VO^2 max ($F=102.14$, $P<0.05$) [74].

Physical activity plays a major role in the prevention and treatment of diabetes. Sufficient Evidence is available to support the increased prevalence of type 2 diabetes in sedentary people. It is known that physical activity yields good health benefits mainly affecting muscles glucose uptake and utilization and liver insulin sensitivity, which eventually leads to glycemic control. Benefits can extend to improvement in lipids profiles, thromboembolic status, body composition, and cardiorespiratory fitness and normalize blood pressure, which all will lead to reduction in cardiovascular risks. Furthermore, physical activity can donate to prevention or delay of known diabetes complications [59], [71], [75]–[82].

Physical activity and cancer

Most of cancer types has environmental components which make individuals more susceptible to neoplasms. Physical inactivity increases the prevalence of some site-specific including colon, breast, and endometrial cancers. Physical activity is associated with a medium reduction in breast cancer with difference between pre- and post-menopausal women with more profound effect in post-menopausal women. Physical inactivity plays a role in breast cancer prevalence through abnormal BMI, insulin resistance and hormonal and inflammation exposure [2].

Overweight and obesity was found to play a major role in cancer burden. Obesity can be linked to carcinogenesis through complex metabolic and endocrine abnormalities which lead to alterations in hormone metabolism, insulin and inflammatory pathways. Normal body weight lowers the risk of most cancers [83]. Physical inactivity increases the risk of breast cancer and proximal and distal colon cancers. Lack of exercise is found to be related to many site-specific cancers. Physical inactivity is considered as a causal factor in cancer through complex multiple interacting mechanisms [61].

Cancer patients receiving treatment may develop fatigue, depression, and decrease in quality of life. Physical activity for cancer patients results in physiological and psychological benefits. Thus physical activity should be considered in cancer therapy [84]. Exercise improves nearly each possible outcome which has a direct significance in cancer patients. It results in improvement in physiological measures like: fitness, body composition and physical function as well as patient-reported outcomes like: sleep quality and fatigue. Emerging evidence indicate the role of

exercise in improvement in clinical outcome through tumor biology. Cancer incidence and tumor growth are evident to be inhibited by exercise. Physical activity has a direct role in cancer progress via effect on tumor-intrinsic factors leading to less cancer adverse events and more favourable effects of anti-cancer therapy. Furthermore, it plays a major role in disease control and recurrence [85].

Physical activity is known to decrease risks of multiple cancers. Insufficient physical activity is considered as cancer risk. Pathway for association between physical activity and cancer might be justified by insulin resistance, immune function, steroid hormones and adipocytokines. Effect of physical activity on cancer survivals includes better quality of life, self-esteem, anxiety and physical fitness. Sedentary behaviour represents an independent risk factor for cancer. Physical activity is strongly evident to protect against colon, breast and endometrial cancers. Modest evidence is available for physical activity protective effect against lung, pancreas, ovary, prostate, stomach and kidney cancer [23].

The National Cancer Institute Cohort Consortium explored the dose response relationship between self-reported leisure time physical activity and mortality. Modest amount of physical activity results in considerable health benefits. Performing less that recommended physical activity resulted in somehow in reduction in mortality risk. Meeting guidelines recommendation by moderate or vigorous physical activity was related to supreme longevity. Performing less than recommended PA resulted in 20% lower cancer mortality risk HR, 0.80 (95% CI: 0.78-0.82), whereas it was 31% and 37% lower for participants performing 1 to 2 times and 2 to 3 times the recommended minimum amount of PA HR, 0.69 (95% CI: 0.67-0.70), HR, 0.63 (95% CI: 0.62-0.65), respectively [86].

Physical activity had a protective effect against cancer mortality. A meta-analysis of cohort studies was done to specifically look for relationship between physical activity and cancer mortality. Study participants of included studies were general population and cancer survivors. Results showed an inverse dose response relationship between physical activity effects and cancer mortality. Participation in physical activity resulted in lower cancer mortality HR, 78 (95% CI: 0.74 to 0.84) [87].

A study looking into the association between cardiorespiratory fitness and physical activity and cancer mortality in 4034 men with age between 21-89 years for 10 years. The study reported that meeting physical activity recommendation along with moderate to high cardiorespiratory fitness has a protective role in cancer deaths. Physically active participants had reduced cancer mortality risk RR, 0.8 (95% CI: 0.67-0.97), P=0.02). Cardiorespiratory fitness (CRF) was inversely associated with cancer mortality (1 MET increase in CRF resulted in 5% reduction in cancer mortality (P=0.01)) [88].

A meta-analysis was conducted to assess the influence of physical activity and weight loss on breast cancer incidence. The analysis included 139 studies. The risk of breast cancer was reduced significantly by physical activity OR, 0.78 (95% CI: 0.76-0.81; P < 0.001) Furthermore, more protective trend was found in women performing high-intensity physical exercise. Cancer incidence risk was reduced with weight loss OR, 0.82 (95% CI, 0.67-0.97) [89].

Physical activity and mental health

Physical activity is viewed as non-invasive therapy for mental, cognitive and psychological health improvements. It has been known to have a major influence in treating and preventing depression and mental issues. People who engage in more PA

have a reduced risk of being diagnosed with Psychiatric disorder. Furthermore physical inactivity has been identified as a risk factor for the development of anxiety and other psychiatric conditions [32], [90], [91].

Depression has major impact on quality of life. Physical activity is thought to have a protective against the onset of depression. A review study was done including prospective-based, longitudinal design studies to examine relationships between depression and physical activity. The review concluded that performing any level of physical activity can prevent against depression. Physical activity can be a valuable mental tool against depression. Based on the review included studies (30 studies) Physical activity is having an inverse relation with depression [92]. Additionally it's considered a strong contributor in the incident of dementia and Alzheimer's disease. Physical inactivity may be a major cause of depression and mental issues. The effect of physical activity on depression is quantified as pharmacotherapy and psychotherapy. Physical activity has a potential role in the prevention and treatment of depression. Induvial who are less active are at more risk for development of depressive symptoms. Furthermore the duration of physical inactivity play a major role in the increased risk of depression [61].

A cross sectional study investigated the association of physical activity volume and context on mental health of youth post-secondary school age 16 to 24 years old. The study included 1527 participants in Canada using self-reported physical activity questionnaire. Physical activity volumes especially moderate to vigorous was positively associated with good mental health β=0.072 (95% CI: 0.045-0.099). Furthermore, high physical activity was inversely associated with depression and anxiety β=−0.011 (95 % CI: −0.020-0.001) [93].

Another 26 year follow up cohort study in Denmark examined the impact of leisure time physical activity on depression. The study included 18,146 individuals. Physical activity was measured using “The Copenhagen City Heart Study Leisure Time Physical Activity Questionnaire”. The study concluded women with low physical activity have more risk for development of depression. Women with a low level of PA have HR, 1.8 (95% CI: 1.29-2.51) for depression compared with women with High PA [94].

A survey was done to evaluate the relationship between physical activity and mood in 1042 participant in Brazil. It mainly focused on symptoms of depression and anxiety. The sample included both gender with a mean age of 41.9. The studied measures included demographics, physical activity classification and depression / anxiety using the Beck Anxiety and Depression Inventory. Participants who lack of engagement in physical activity were two times more likely to develop anxiety (PR=2.5) and depression symptoms (PR=2.1) [95].

Another Cross-sectional, community-based study was done utilizing data from world health Survey to explore the global prevalence of anxiety and its association with PA. The study included 237,964 individuals from 47 countries aging between 18-96 years old. Physical activity questionnaire short form was used to categorize individual level of physical activity as low, moderate or high. Data on physical activity was available for 38 countries. Overall prevalence of anxiety was 11.4%. Engagement in low physical activity increases the odd of anxiety by 1.32. Low levels of physical activity were observed to the highest in United Arab Emirates (50.9%). Low physical activity was associated with increased prevalence of anxiety 1.32 (95% CI: 1.17-1.47).

Older age, female gender, low education level and low socioeconomic status were also associated with low physical activity [96].

Physical activity and occupation

A systematic review was conducted to evaluate south Asian county physical inactivity/activity patterns. It explored PA variations with gender and area of residence in different domains (work, transport, leisure). The study reported that inactivity mainly rely on occupations, transport means, social and cultural values which is different in developed world. Skilled labours and professionals were more inactive than unskilled workers. Also, higher education was a major influence of physical inactivity. There is a varied dissimilarity in the prevalence of physical inactivity among South-Asian adults within and between countries. Therefore it is hard to comment about the overall prevalence of physical inactivity in the region. In females, skilled and professionals jobs and higher education was indicative of inactivity. Leisure time inactivity was common in Asian adults Factors such as being female OR=2.1, age >70 OR=3.8, Muslim OR=2.7, Urban residence=2.5, higher education OR=3.6, DM OR=1.6, Metabolic syndrome OR=1.3 and hypertension OR=1.2 all significantly increased odds of being ‘inactive’ [97].

Literature explored the association between occupation and coronary artery disease. Physically active jobs result in fewer incidences of coronary and ischemic heart diseases. Research focus on the occupational health of bus drivers as they exhibit physical (cardiovascular disease, and fatigue) and psychological (depression and anxiety)

illness. London's double-decker buses drivers die due to coronary heart diseases unlike the conductors on the same buses. Moreover, administrative

governmental workers exhibit rapidly cardiac infarction which is fatal compared to postmen. The study showed that physical activity at work was protective against coronary heart diseases in middle aged men, moreover, men in physically active job exhibit less severe symptoms and develop symptoms later that men in physically inactive jobs [98], [99].

A few studies investigated the effect of profession on health outcomes. A study was done in Azerbaijan to assess the prevalence of metabolic syndrome among professional long distance drivers. The study included 12,138. The result of the study suggests that metabolic syndrome has become a noteworthy health problem among Iranian long distance drivers. Among 12,138 participants, 3697 subjects found to have metabolic syndrome. Based on Body mass index (BMI), 5027 subjects (41.4%) were overweight (BMI 25.01–30 kg/m^2), and 2592 (21.3%) were obese (BMI 30.01 kg/m^2). The presence of central obesity was more common than other components. The study concluded a significant association between metabolic syndrome and BMI, smoking, age and driving experiences [100].

Another study was done to detect the Prevalence of undiagnosed diabetes mellitus and cardiovascular risk factors in Hong Kong professional drivers. The study concluded that professional drivers have higher prevalence of undiagnosed DM 8.1% (95% CI: 7.1-9.0) and metabolic syndrome 10% (95% CI: 9.0-11) than the general population. The study was genuine in examining the glucose tolerance status and cardiovascular risk factors. This result can be explained by their poor lifestyle of long working hours, lack of exercise and unhealthy eating habits [101].

Another study was done in city of Korea to detect cardiovascular risk among bus drivers, as professional drivers are known to have a higher risk of developing CHD because of the stressful nature of work and higher workloads. The nature of their work involves driving in heavy traffic, obesity, low physical activity, high demand and low decision autonomy. This study concluded that Middle aged male drivers in a big city of Korea stand a higher chance of developing CV event than other professions of the same age. Odd ratio cardiovascular risk in alternate shift was 2.58 (95% CI: 1.33-5.00) in comparison with double shift pattern [102].

Furthermore a study was done to detect the main factors associated with obesity (individual and transportation) and its prevalence among Italian professional drivers. Result showed that obesity is prevalent in Italian professional drivers. More than half of the population of PDs (61.6%) was characterized as overweight or obese. Numerous significant correlated risk factors were recognized both on the individual and occupational level. High educational level is an independent protecting factor against obesity OR, 0.32 (95% CI: 0.11-0.90) [103].

A similar study was done in Iran to investigate obesity, hypertension and hyperlipidaemia, and carbohydrate metabolism disorders such as diabetes mellitus among drivers. Results showed that Hyperglycaemia was found in 52.1% of the drivers, 9.1% of them were in diabetic stage, and with HbA1C criteria. Excessive body weight was recorded in 65.6% of the study population, 44.8% were diagnosed with overweight and 20.8% with obesity. High blood pressure prevalence within drivers was 16.4%. The study concluded High prevalence of excessive body weight, high blood pressure and hyperlipidaemia in professional drivers, which are considered as risk factors for diabetes mellitus. Prevalence of DM increase with age above 40 OR,

4.25 (95% CI: 3.01-6.78). OR of Hyperglycaemia in the overweight was 1.96 (95% CI: 1.34-2.84). Overweight was a risk factor for hypertension OR, 2.12 (95% CI: 1.58-2.84) [104].

Occupational driving may increase cardiovascular events. The study looked into risk of overall cardiovascular events in occupational professional drivers against matched controls in a cohort of people with diabetes (n=6563). The study concluded an increase in overall cardiovascular events in occupational drivers despite similar risk factors. Adjusted CVD events risk in occupational professional drivers was 1.92 (95% CI: 1.46-2.51)($P < 0.01$) [105].

Physical activity and migrant population

The studies about immigrant population reported an overall health decline after residing in different environment. This decline is mainly attributable to lifestyle changes and sedentary behaviours fostered in the host country. Immigrant population face a challenge when resetting in developed culture which is different to their home country. These migrants encounter an augmented health risks physically and mentally. These effects is found to be significantly linked to cardiovascular diseases and mortality in migrant population living in developed countries [37]. This conception is known as acculturation. This term is principally used in discussing conditions related to immigration to a new country which is different that the country they were born at. It describes the struggles of this vulnerable population in term of personal, social and cultural consequences. Data on acculturation effects on PA and its impact on health and wellbeing of immigrants is limited. Furthermore, migrants are coming from different and culturally diverse populations which make it difficult to understand.

Acculturation is an essential part of immigrants health as it examine incorporation of behaviours that are detrimental to health, such as diet, PA and smoking [106], [107].

Countries experiencing large waves of immigration attempted to understand the health status and needs of immigrants because of their growing numbers and their contribution to the health of the nation. This task is challenging mainly because of the heterogeneity of immigrant populations, and uncertainty about how migration affects health [15]. Some studies have shown that immigrants enjoy superior health compared to the health of host society. As immigrants adopt the host society health behaviours over time, their health status begins to converge with that of the developed country [16], [17]. Moreover, ethnicity of migrants in the host country is poorly measured in epidemiological studies. When aimed to understand PA in ethnic groups, the influence of other factors related to having an ethnic background may be missed [18].

Settlement in a high income countries causes substantial alteration in obesogenic behaviours in the host society as it accelerate overweight and obesity susceptibility. Changes in the obesogenic behaviour occur as a result of acculturation [19]. The WHO (World Health Organization) defines obesity as a BMI (body mass index) of 30 kg/m^2 or more, and considers obesity as a visible but neglected health issue [108]. While migration and urbanization have been linked with higher obesity rates, especially in low-resource settings, prospective information about the magnitude of these effects is lacking. Over the last three decades, the global prevalence of overweight and obesity has increased. The obesity-related burden is increasing worldwide, and its association with a number of non-communicable diseases has been described [109]–[112].

Population based surveys data was pooled to report levels of PA during different domains including: work, home, transport and leisure time across 168 countries including 1.9 million participants between 2001 and 2016 [113]. Insufficient levels of PA were assessed based on WHO recommendations. An insufficient level of PA, which is a leading risk factor for non-communicable diseases, was 27.5% worldwide in 2016. Levels of insufficient PA in South Asian were one of the highest levels accounting for 43.0% .

Migrants in GCC

The Gulf cooperation Council (GCC) countries are becoming a focal point for economics. This resulted in the current status of the labour migration. Several factors contributed toward making this region a strategic area for migration. These factors include: energy resources, increasing financial power, and the critical strategic military as well political place. The economic revitalization has increased the demand for migrant labour, mainly the enormous demand for labour by large infrastructure projects, which is reflected in the high growth rates in population and labour force. The whole GCC countries, enjoys a wide variety of expatriates from diverse ethnic backgrounds [114], and majority of the labour force has arrived form Asian countries [115].

Minimal data is available on the prevalence of PA and its effect on various health outcomes in the UAE. Although, South Asian expatriates constitute the largest proportion of the UAE population, there is a lack of research exploring the prevalence of and determinants or correlates of different chronic disease risk factors and health outcomes [20].

Migrants in UAE

The UAE population consist of multi-national residents with diverse educational backgrounds, religious beliefs, and cultural norms. Natural growth and migration result in the formation of UAE demographics and population growth. The UAE has witnessed fast-paced economic and industrial developments which mandated the recruitment of migrant workers from all over the world to fulfil the manpower demands. Therefore, the population growth over the past four decades has been mainly due to the high inward migration. This has formed a unique population structure as illusrtated in Figure 1. Expatriates account for 80% of the UAE population. Among immigrants, the ratio of males to females is nearly 4:1. This imbalance is due to high male immigrant employment in construction compared with migrant females working in hospitality, health care, or domestic service. Looking further to the distribution of migrant workers by nationality; construction labours and manual workers tend to be from the Indian subcontinent; middle managers and health care workers from the Philippines, India, and neighbouring Arab countries; and senior management and consultants from the UAE, Europe, North America, and Australasia [14], [116].

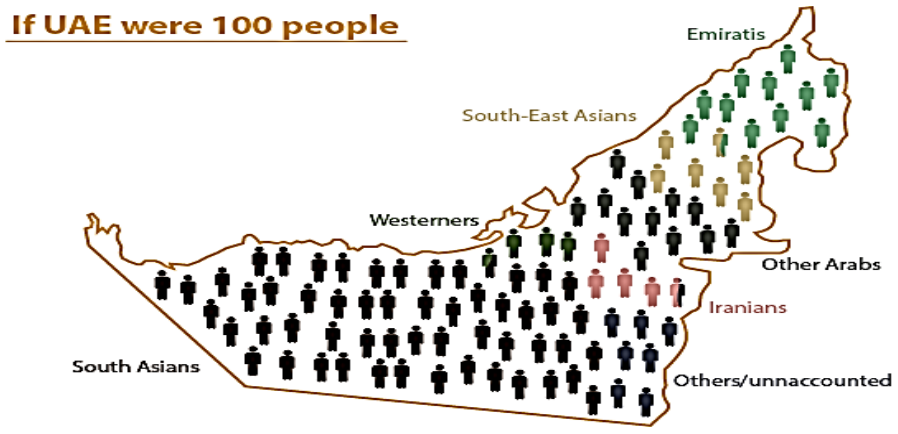

Figure 1: Demographics in UAE

Immigrants in the UAE differ substantially from the natives in terms of demographic and socioeconomic characteristics. The counry itself has changed from a developing phase to a modern and wealthy country with a Western lifestyle. This economic growth had a positive social and health outcome, including increasing life expectancy. Conversely, rapid development and urbanization have supported a significant problem of chronic diseases, particularly obesity-related cardiovascular risk [13]. This growth led to accompanying increased caloric intake, and decreased PA which rapidly increased the prevalence of obesity [117], [118].

Migrants are moving from developing countries to economically developed countries. The immigrant's exposure to environmental factors plus lifestyle transition may place them at a higher risk for developing metabolic risk factors .The theory of a Healthy Migrant Effect seen in Western countries may be transformed in UAE. It entails that upon arrival, migrants are healthier than the native population; nevertheless, their health status decreases as the length of their stay increases [119]. Reasons for the healthy migrant effect include the positive selection bias that the official migration process enforces, such as the pre-migration rigorous health checks [107]. Longer length of residence in the UAE is associated with a higher prevalence of diabetes. There are high levels of overweight, obesity and central obesity amongst migrant women in the UAE and after ten years, migrant women have three times the prevalence of type 2 diabetes compared with more recent arrivals. It is likely that changes in diet and lifestyle account for these findings [19].

All expatriate workers looking for a job in the UAE are required by federal law to undergo a health and communicable disease screening test at a government visa

screening centre before receiving a residency permit. Most of the workers are low-paid, semi- or unskilled, without long-term job security, living alone or in shared accommodation, and separated from their families, they often suffer from stress, anxiety and depression [120], still fewer information are available regarding expatriate workers in UAE [20].

South Asian Immigrants

South Asians consist of residents of India, Pakistan, Bangladesh, Sri Lanka, Nepal, Bhutan and Maldives. These countries represent 24% of the world's population [121]. Non-communicable diseases are considered as threat to health in south Asians. In south Asian countries, obesity is an evolving health challenge. Prevalence of obesity is more evident in urban regions. Additionally the rate is high in adolescents and children. Furthermore, South Asians have high abdominal obesity with more intra-abdominal and truncal subcutaneous fat compared to white Caucasians. Another characteristic of South Asians obesity include the build-up of fat in liver and skeletal muscle. All these result in more insulin resistance and metabolic disorders. Overall, obesity rates have risen in all studies done in India and other South Asian countries in general [82].

Major focus of south Asian populations is because of their high burden of cardiovascular diseases as result of high insulin resistance, diabetes and genetic predisposition. The systematic review highlighted the poor cardio metabolic health as well as the biological mechanisms pertaining to south Asian migrant's population. These mechanisms explained the cardio metabolic risk of these populations at lower BMI. Other influences of this risk include diet and physical activity patterns [122].

The PA recommendation for BMI and waist circumference thresholds can vary based on ethnicity. Data provide evidence that a dose response relationship between PA and metabolic disease risk varies within population from different ethnic origins. The current recommendation is mainly based on white European population. Ethnicity-specific physical activity guidance conceptualize that South Asian men need to undertake more PA than Europeans to demonstrate similar cardio- metabolic risk profile. This requires a consideration of lower BMIs and waist circumferences for south Asian in order to confer cardio metabolic risk factor [123].

Global studies on physical activity in migrant workers: Studies done in developed countries

A review paper stated that South Asians have more risk related to development of obesity related non-communicable diseases including metabolic syndrome and insulin resistance when compared to white Caucasians. This may be related to nutritional and lifestyle transitions including nutritional imbalance and physical inactivity. Associated risk factors of South Asian may be determined by body fat, central obesity and biochemical markers [8].

A study was done to investigate the threshold level of PA in various ethnic groups. The study confirmed the finding that cardiovascular risk increase by low levels of PA especially in Europeans population. PA benefits mainly cardiovascular benefits are known in all population, but the threshold specific to each population is unknown. Moreover, the study reported that South Asians have increased cardiovascular risk due to decreased cardiorespiratory fitness and lower fat oxidation. South Asian migrant's population are at high risk for development of cardiovascular disease especially type

2 diabetes because of adiposity, central fat, insulin resistance and genetic predisposing. South Asians have lower PA level and cardiorespiratory fitness levels. South Asians were reported to be 50 % lower than European in any type of exercise [124].

Another cross sectional study was done in the USA among South Asian population to explore diet, acculturation and health outcomes mainly metabolic syndrome. The study included a sample of 401 low income South Asian adult males and females. The participants were interviewed by questionnaires to obtain an acculturation index. The study reported that males had better diet than females. Metabolic syndrome was reported more in males with poorer diet. New migrant females had a higher metabolic syndrome prevalence and lower diet quality. More acculturated participants had a higher quality diet compared to less acculturated participants [125].

A study done in the United Kingdom (UK) to assess why South Asian male immigrants (n=54) have increased central obesity and type 2 diabetes mellitus compared with white British. A mixed-methods cross-sectional design was utilized to objectively and subjectively measure PA in this population and to explore factors influencing it. International Physical Activity Questionnaires (IPAQ) long form and accelerometry were used to assess PA. Results concluded that South Asian men were not meeting the recommended PA bouts. Furthermore, the study reported that South Asian men are more physically active than previously reported in studies using objectively measured methods [126].

A cross-sectional study conducted in Scotland to explore PA level in south Asian population compared to Europeans, as South Asians are known for their greater

cardio metabolic risk. The study included 148 South Asians and 163 white Europeans with age between 18 and 70 years. PA was assessed using accelerometers. Biochemical markers including fasting glucose, glycated haemoglobin (HbA1c) and lipids were collected. South Asian were less active and had more insulin resistance and fasting glucose. Study concluded that South Asian adults needed to undertake 232 min/week of moderate PA to yield and modify their cardio-metabolic risk factor score to be comparable to white Europeans undertaking 150 minutes/week of moderate PA per week [127].

Another study which was done in the UK hypothesized that South Asians have high risk for CVD which is not fully explained due to a unique phenotype of increased levels of visceral adiposity and subcutaneous abdominal adipose tissue at lower BMI. The comparison for cardiovascular risk factors and demographics were done for 207 South Asians and 201 Europeans . Study measures included sociodemographic, family history mainly cardiovascular diseases or type 2 diabetes mellitus, body composition including body fat and abdominal adipose tissue and metabolic risk factors. The study mainly explored effects of total body fat and abdominal adipose tissue. Finding reported worse lipid profiles, C-reactive proteins and insulin in South Asians even after confounder's adjustments. Overall, South Asians had higher metabolic risk factors than Europeans even after adjustment for BMI [128].

A cross sectional study was done on immigrant population in Canada to explore their PA behaviour and how it changes as they adapt to a Canadian lifestyle. Self-reported LTPA was analysed and adjusted for several factors to quantify its relation to time since immigration. The study reported that 11% of immigrants were from South Asian and 14% were from East/Southeast Asian. South Asian men and women had the

lowest prevalence of PA. Ethnic differences in the prevalence of PA by time since immigration showed similar patterns for men and women. Overall, the study revealed that immigrants had superior health compared to non-immigrants, but they were less likely to be physically active. Recent immigrants were less active and amount of time spent in Canada seems to improve probability of being physically active during leisure time. The study suggests that "healthy immigrant effect" decreases with increased time since immigration as well as the overweight incidence increases. In general, immigrants in this study increase their LTPA since immigration. Though there is an increase in PA, there is a progressive increase in BMI. This can be explained by decreased occupational or non-LTPA or increased in caloric intake [129].

A meta-analysis and literature review was done on South Asians Canadian population as they have a higher risk of certain cardiovascular disease (CVD) compared with white people. The study mainly compared cardiovascular risk factors and disease management practices among adult South Asians and white Canadians. The review included 50 articles and 5 805 313 individuals. Included studies were mainly interventional and observational studies which assessed biological mechanisms underlying CVD risk in South Asians. The review concluded that South Asian Canadians had a higher prevalence and incidence of CVD risk including: diabetes mellitus OR, 2.25 (95% CI: 1.81-2.80), and hypertension OR, 1.11 (95% CI: 1.02-1.22). Apparently, South Asians had lower HDL and an increased prevalence of diabetes, hypertension and body fat. This might be explained by the sedentary life style and the higher consumption of carbohydrates of South Asian population [6].

A cross-sectional study of Carotid Ultrasound and Risk of Vascular disease in Europeans and South Asians men living in UK (CURVES) was conducted to explore

if this increase in cardiovascular risk in South Asians may be related to low PA level and cardiopulmonary fitness. PA was measured using accelerometer in a pair of 100 south Asian and Europeans aged between 40 and 70 years. The collected data included demographics, blood tests, body composition. The study examined the relationship between diabetes and body size, fitness and PA. Body fat and waist to hip ratio were higher in south Asian, whereas, oxygen uptake (VO_2max) and MVPA were lower. Diabetic indicators including insulin resistance and fasting blood sugar were higher among South Asians which can be justified by lower cardiopulmonary fitness [130].

Furthermore, South Asians have high risk of coronary heart disease (CHD) as an ethnic group. PA is a way of explaining this increased risk due to its relation to CHD risk factors such as central adiposity, insulin resistance and lipids. Nationally representative longitudinal data was obtained from Health Survey of England on 8974 white participants and 5421 South Asians to assess relation between PA and CHD. Participant included both males and females aged between 18 and 55 years. Metabolic equivalent of task (METs) as expressed by minute/week were lower in south Asian population, although, their BMI was lower than Europeans. Furthermore, PA level differed in south Asians population with higher PA level in south Asians who were born in UK. Waist to hip ratio was higher is south Asians. Additionally PA was found as a contributor to CHD risk in South Asians [131], [132].

Non- communicable diseases are escalating in south Asians. Furthermore it's considered as main contributors to mortality in south Asian population. South Asians display a high risk of these diseases compared to reference. Rates of non-communicable diseases are escalating in South Asians [133]–[135].

A study was done in South Asian living in New Zealand to assess body fatness, body composition, PA and nutritional behaviour. It included 112 participants of both gender aging between 44 and 91 years who lived in New Zeeland for an average of 51 months. Measures included anthropometric measures, body composition and central obesity. PA was measured using pedometer. Furthermore, a health and lifestyle questionnaire was administered to participants to assess their nutritional status. PA steps were lower in both genders with females showing lower steps compared to males. There was an inverse association between pedometer steps and waist circumference. Utilizing Asian Indian specific cut off, females displayed higher BMI and body fat compared to males. Sixty nine percent of participants were classified as obese, whereas 13.7% were overweight. Majority of participants had abnormal waist circumference and body fat percentages which is associated with risk of non-communicable diseases. Most of the participants (74%) reported presence of chronic condition such as diabetes (35%) and other non- communicable diseases. Finally, time spend in New Zeeland was associated with better nutritional habits [136].

A cross sectional study was done in the UK to investigate non communicable diseases in South Asians,and its associated risk factors including PA. Type and level of PA was assessed as well as its relation to selected cardiovascular diseases. PA was measured using interviewer administered questionnaire that mainly focused on occupational and LTPA. Other collected measures included demographics, blood pressure, heart rate, biochemical and anthropometric measures. Study sample included both males and females aged between 25-75 years. Europeans have higher PA level with 52% who don’t meet PA recommendation compared to 71% Indians, 88% Pakistani and 87% Bangladeshis. Europeans participated in more MVPA and

recreational PA. An inverse association was found between PA and blood pressure, blood sugar and insulin, BMI and waist circumference. However, the study did not find ssociation between PA and lipids [137].

A cross sectional study was done to explore patterns of PA in a multi-ethnic Asian urban population consisting of 2319 participants in Singapore in 2012. Data was collected during the global PA questionnaire. The study also highlighted the sociodemographic contributors of PA. Thirty seven percent of the participants reported high levels of sedentary behaviours while 73.8% met the PA guidelines. There was a significant association between PA and age as older participants were less likely to meet PA guidelines prevalence ratios, 74 (95% CI: 0.61-0.91). Females practiced less PA compared to males PR, 0.63 (95% CI: 0.51-0.76). Full time employment led to less PA and more sedentary behaviours. Also higher education was a predictor of higher PA levels PR, 2.08 (95% CI: 1.45-2.99) [138].

A study which was done in the USA to examine the association between duration of residence and cardiovascular disease risk factors among South Asian immigrants. A random sample of 1169 was collected from the California Health Interview Survey. The participants were south Asian aging 18 years or above. Cardiovascular risk factors included diet, PA, obesity, hypertension, diabetes, high lipids, smoking and drinking alcohol. The study concluded that collates of obesity included 15 years of residence in USA OR, 0.59 (95% CI: 0.35-0.98), daily fruits and vegetables consumption OR, 0.37 (95% CI: 0.15-0.94) and sedentary behaviors OR, 2.11 (95% CI: 1.17-3.81) [139].

A prospective cohort study with 21 years follow up study of South Asians and Europeans aged 40-90 years was done in the UK investigating health behaviors effect on CVD. The study focused on association between health behaviors and CVD risk as south Asians are considered high- risk group having more predisposition to CVD. Health behaviors included smoking, alcohol intake, PA and fruit/vegetable intake. Lack of compliance to positive health behaviors resulted in 2 to 3-fold-increased risk of incident CVD in both groups. Adjusted HR for CHD incidence in the Europeans was 2.45 (95% CI: 1.18-5.10) for zero health behaviors and 3.48 (95% CI: 1.38-8.81) for South Asian. HR of incident CVD for Europeans was 2.12 (95% CI: 1.14-3.94), and 2.73 (95% CI: 1.20-6.21) for South Asians. European population attributable fraction was 43% for CHD and 28% for CVD, whereas, it was 63% and 51% respectively for south Asian [140].

Other Asian origins studies

A cross-sectional survey was conducted in the USA to investigate the patterns of PA and its demographic characteristics in Korean immigrant's women. The study used IPAQ to assess PA in 197 women. The most prevalent pattern reported was inactivity in all domains of PA aside from household PA [141].

Another systematic review was done to check variability in PA within South Asians in the UK. South Asians are considered the least active people in the UK, but little is known about how PA varies within and between different UK South Asian groups. The systematic review mainly included 46 quantitative cross sectional and qualitative studies. The PA of the included study was measured in both subjective and objective techniques and the study population were both males and females. The study concluded a clear variation in PA levels among South Asians residing in the UK.

Second-generation South Asians are more physically active than first-generation. Though they are active, still they are less active than the white British. An explanation for this might be that second-generation South Asians have a more positive attitude towards PA than the first-generation [142].

Another study investigated PA and sedentary behaviors of Japanese population in western world. A cross sectional survey was done to compare PA levels of 97 Japanese residing in the Western world with age and gender matched Japanese residing in Japan. The study used self-administered questionnaire to assess PA and sedentary behavior and categorized PA into 3 domains light, moderate and vigorous. The levels of PA were found lower in Japanese population living in the USA when compared to native Japanese. In the USA, only 45% of males and 26.3% of females fulfilled the recommended daily PA. Furthermore, engagement in MVPA was also lower in Japanese population living in the USA. Females in the USA showed lower sedentary time when compared to native Japanese counterparts while males showed less sitting time during weekend. The study did not find association between sedentary/sitting time and exercise time in the target population [37].

Studies done in developing countries

A study was done in New Delhi, India and Karachi, Pakistan enrolled in 2010–2011 to evaluate the effect of replacing 30 min/day of sitting by 30-min/day of walking or MVPA in relation to cardiovascular risk. Participants included 6991 South Asian population (males and females) age 20 or above who were free of cardiovascular disease at baseline. Data regarding sitting and PA was collected using the short form of International Physical Activity Questionnaire. A total of 76.7% of participants were categorized as sedentary. Substituting walking or MVPA for sitting resulted in lower

diastolic blood pressure (β=-0.08 (95% CI: -0.15-0.0003)), lower BMI (β=0.08 kg/m^2 (95% CI: -0.15--0.02)), waist circumference (β=0.25 (95% CI: -0.39--0.11)) and higher high-density lipoprotein cholesterol (β= 0.13 (95% CI: 0.04--0.22)) [143].

A review study was done in 2018 to explore contributors of metabolic syndrome and type 2 diabetes in South Asian population. The review incorporated body fat in context of metabolic syndrome in south Asian living in India, Pakistan, Sri Lanka, Bangladesh, Nepal, Bhutan and Maldives. When research data on South Asians living at native countries were unavailable, those residing in the USA, UK, Europe, Asia (mainly Malaysia and Singapore), South Africa, Mauritius and Fiji were included in the study. The literature involved studies on abdominal obesity, insulin resistance mechanism and type 2 diabetes mellitus from 1966 to March 2018. The review reported that South Asians have higher total and abdominal obesity at a lower BMI compared to Whites. Furthermore, they have lower skeletal muscle mass, PA and high consumption of carbohydrates and saturated fats. The review explained this by the rapid economic transition and urbanization of the South Asian region. It reported that 90% of males and females in India are not performing regular recreational exercise. It also reported a higher hours of television viewing in all age groups. Furthermore, the literature found an inverse relation of PA and BMI, waist circumference, systolic blood pressure, plasma glucose and insulin levels. The review concluded that PA guidelines need to be revised to reflect the ethnic phenotypic and lifestyle characteristics of South Asian [144].

A systematic review was conducted to evaluate South Asian county PA patterns. It mainly focused on the prevalence of physical inactivity, its variations with gender and area of residence. Furthermore, it compared PA levels in 3 main domains:

work, transport and leisure. The study concluded that physical inactivity was mainly influenced by occupations, transport means, social and cultural values. The three domains were apparently dissimilar compared to developed world. Asian adults generally reported leisure time inactivity. Inactivity was reported more in skilled labors and professionals compared to unskilled workers. Moreover, physical inactivity was highly correlated to education level. Higher education and professional jobs were indicative of inactivity in females. The review compared the prevalence of physical inactivity among South-Asian adults within and between countries and reported a diverse variation. Thus, it was hard to conclude a result about t the overall prevalence of physical inactivity in the region [97].

Another cross sectional study in India explored the prevalence of hypertension in male gulf migrants versus non-migrant's workers in Kerala. The study participants consisted of multistage random sample of 191 migrants and 193 non-migrants aging between 25 to 64 years. Since all migrants from Kerala were men this study didn't include any females. Collected data included socio-demographic data, PA, tobacco and alcohol consumption and nutritional data (fruit and vegetables consumption). Data were collected using non-communicable diseases questionnaire coupled with anthropometric data of height, weight and waist circumference, blood pressure, tobacco and alcohol consumption and PA. Migrants were more likely to be hypertensive 57.6% (OR, 3.00 (95% CI: 1.83-4.9)) [145].

Another community-based survey was done in South Asian living in Calcutta, India in order to investigate the relation between PA and metabolic syndrome. The study included 448 males and females ageing more than 30 years. Data collected included measures like anthropometric characteristic, blood pressure, dietary intake

and PA. Metabolic profile was considered based on waist circumference, blood Lipids, blood pressure and blood sugar. PA was measured using self-reported schedule to capture activity during work, leisure and recreational, house chores and sedentary time over the last week. The study concluded that PA played a vital role in the prevention of metabolic syndrome. Moreover, there was an inverse relation between PA levels and metabolic syndrome. Furthermore, participant with low PA levels were having high BMI, Waist circumference, waist to hip ratio and lipids intake [146].

Studies done in MENA and GCC Region

A cross sectional study done in Saudi Arabia to assess the impact of living in Saudi Arabia on expatriate employees and their families' behavioral cardiovascular risk factors including diet and PA. The study included 1437 expatriates, of them 1091 (75.9%) were Arabs, 309 (21.5%) were South Asians and 37 (2.57%) were from different nationalities. PA was measured subjectively and included domains related to work, traveling to/from places or recreational activities. The study concluded that study participant were physically inactive and consumed more fast food and less fruits and vegetables. PA patterns domains in general were affected negatively by living in Saudi Arabia. Consequently, living in Saudi Arabia noticeably reduced the number of days and duration of PA. This reduction in PA pattern was more apparent during the first 5 years of residence in Saudi Arabia. Men witnessed a higher incidence of physical inactivity in both work and recreational domains [147].

A cross sectional study was done in male South Asian migrants in the UAE in order to explore association between acculturation, obesity and cardiovascular risk factors. South Asian migrants constitute around 65% of the UAE population. The study included a random sample of 1375 participants. Results reported high rates of

overweight, obesity and central obesity rates. Moreover, the results showed high rate of hypertension and diabetes. Acculturation from 6 to 10 years was highly related with central obesity (AOR, 1.63 (95% CI: 1.13-2.35)), when compared to 1-5 years of residence (AOR, 1.95 (95% CI: 1.26-3.01)). Acculturation mainly diminished the health of migrant due to lifestyle changes [20], [148].

Another cross sectional was done in the UAE to explore diabetes mellitus type 2 on expatriate women as data is limited on the topic despite the documented high rate of obesity. The study included 599 participant who were all females aged 18 and over in Al Ain City. Participants were mainly from Philippines, South Asia and Arab countries. Diabetes was diagnosed using American Diabetes Association criteria. Other data included demographics, anthropometric data, and biochemical measures combined with IPAQ questionnaire. The study concluded a type 2 diabetes mellitus rate 1.7% for Filipinos, 12.2% for Arabs and 16.7% for South Asians. Furthermore, the result showed that type 2 diabetes mellitus is particularly high among South Asians (AOR, 2.10 (95% CI: 0.94-4.70)). Positive correlations were found with the length of residence in UAE mainly over 10 years (AOR, 2.74 (95% CI: 1.21-6.20)), and age above 40 years (AOR, 3.48 (95% CI: 1.53-7.87)) [19].

Furthermore, a cross sectional study of male South Asian migrants was conducted in the UAE. The study included a sample of 1375 of South Asian adults aged 18 and over. Data collection included demographics, anthropometric data, blood pressure, lifestyle factors including PA. The study investigated the prevalence, associated factors, awareness, treatment, and control of hypertension. The study concluded a high prevalence of hypertension in male South Asians in UAE (30.5% (95% CI: 28.0-32.8)) which is higher than the prevalence in the immigrant's home

country as well as in UAE national and Arab population. Moreover, participants with hypertension were physically inactive (AOR, 1.79 (95% CI: 1.24-2.60)), obese (AOR, 2.49 (95% CI: 1.51-4.10)) and had truncal obesity (AOR, 2.01 (95% CI: 1.37-2.92)). Furthermore, the awareness, treatment, and control of the disease were very little [119].

Chapter 2: Research Method

2.1 Study Design

This study is a cross-sectional descriptive design. Ethical approval was obtained from the Al Ain Medical District Human Research Ethics Committee, and the Abu Dhabi Health Services Company's Research Committee. Written informed consent was obtained from all participants. The Figure 2 below illustrates the sampling technique and flow chart used for the study.

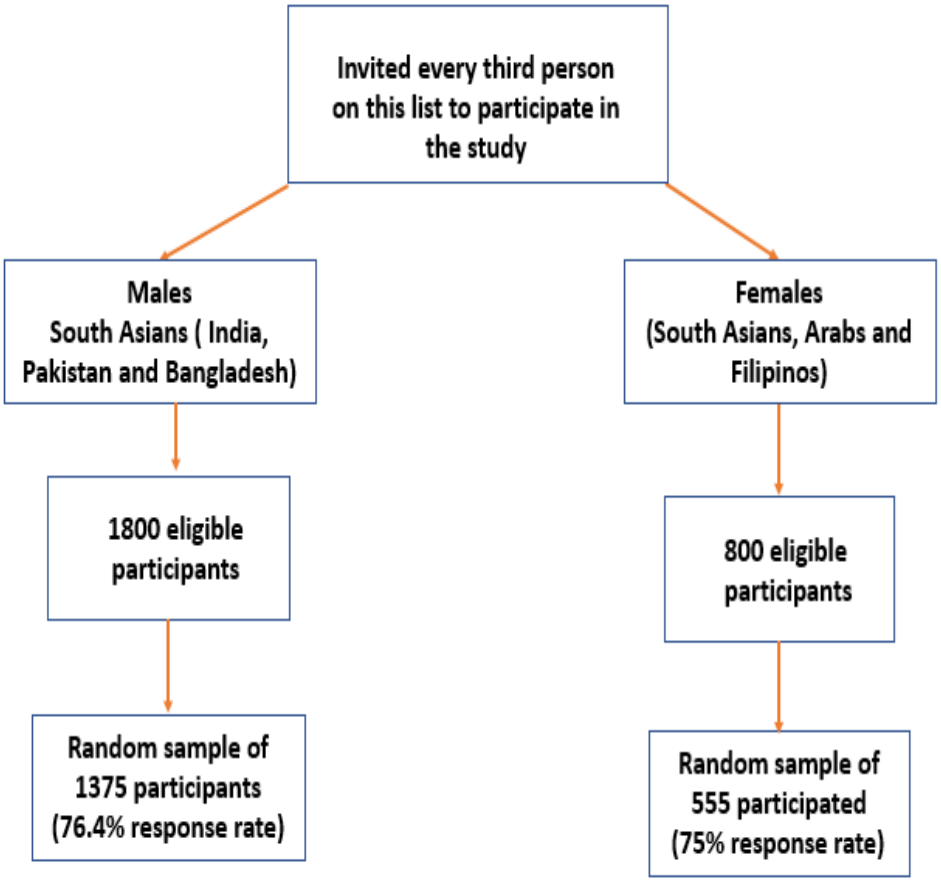

Figure 2: Flow Chart of Study Participants

2.2 Sample and setting

2.2.1 Male Sampling

This study was conducted between January and June 2012. Male immigrants passed through the visa screening center (Disease Prevention and Screening Centre, Preventive Medicine Department, Health Authority Abu-Dhabi) in the city of Al Ain (second largest city belongs to Abu Dhabi Emirate) to obtain or renew a visa [20]. As a governmental law all expatriate workers seeking employment in the UAE are screened for communicable diseases, such as tuberculosis (by chest X-ray) and human immunodeficiency virus (by serology), before acquiring residence status and for some categories they will be tested for Hepatitis B or syphilis specially for food handlers. Expatriates are also required to undergo screening when they renew their visa which is usually every 1-3 years.

A total of 181,231 male immigrants passed through the visa screening center (Disease Prevention and Screening Centre, Preventive Medicine Department, Health Authority Abu Dhabi) in the city of Al Ain (second largest city belongs to Abu Dhabi Emirate) to obtain or renew a visa [20]. Informed written consent was obtained from all the participants. Every third migrant worker (from India, Pakistan and Bangladesh) who visited the Preventive Medicine Department in Al Ain for a health examination were requested to contribute in the study. Of the 1800 eligible participants, 1375 (76.4% response) participated in this study. Formula for binomial distribution ($n=Z^2P(1-p)/d^2$) was used to estimate the sample size. The sample size of this study was based the need to explore differences among subgroups of population. A difference of 1/3 standard deviation in a continuous measure such as minutes of physical vigorous activity, a sample size of 250 per group in a two equal group comparison (total n=500)

will be needed for a significance level of 5% and a power of 80%. The study had a total of 1800 eligible participants, and 1375 participated in the study.

2.2.2 Female Sampling

The sampling frame for the female study was a list of all the female expatriate workers (aged ≥18 years) who were enrolled for examination at the screening center in Al Ain, Abu Dhabi, UAE. A formula for binomial distribution ($n=Z^2P\ (1-p)/d^2$) was used to estimate the sample size (n=500). To account for refusals the sample size was increased and targeted 600 participants. Every third person was invited to participate in the study. Data collection for this study took place between 01 November 2012 and 31 May 2013. Exclusion criteria included female UAE citizens, female migrants from other countries (i.e. not Arab or South Asian countries or the Philippines), and females not providing consent.

2.3 Data collection

An adapted version of the questionnaire used in the "STEP wise approach to Surveillance" (STEPS) developed by the World Health Organization (WHO) for the measurement and surveillance of non-communicable disease (NCD) risk factors in populations was used. Due to the anticipated low literacy rates, the questionnaire was interviewer administered and interviews were conducted in Urdu, Bengali (India, Pakistan, Bangladesh), Tagalog (Philippines) or Arabic by a native research assistant from these countries who had received appropriate training. Data included demographic characteristics, lifestyle risk factors (including tobacco use and physical activity), family and personal disease history, home country residence setting (rural,

urban, and semi-urban), occupation, monthly salary and current type of accommodation.

All consent forms and questionnaires used in the study were written initially in English then it was translated to native languages of the workers, then pretested in the pilot study and finalized after revision and necessary modifications. The questionnaire comprise of an modified version of WHO STEP wise approach to Surveillance, "STEPS", established by WHO for the measurement of NCD risk factors at the country level [149]. Due to the low education rates among the South Asian expatriate population in the UAE; all questionnaires were taken and completed during an interview with a pure Urdu or Bengali speaking researcher. The questionnaire interview collected information that included demographic characteristics, personal, family and disease history, current and past consumption of cigarettes, alcohol, other forms of tobacco (history of exposure to second hand tobacco), home country residence type (rural, urban), occupation, monthly salary in UAE dirhams (AED), how long been in the country (years of residency in UAE), different accommodation type, and detail of performance of physical activity. Monthly income was classified as bottom quartile (AED <900 per month), second quartile (AED 900 to <1200), third quartile (AED 1200 to 2000), and top quartile (>2000). The study measured physical activity using IPAQ short form. Three categories of years lived in the UAE was used (<5 years, 5 to 10 years, and >10 years).

Body weight and height measurements were completed with the participant wearing light clothing without shoes and standing steadily without movement. It was measured (to the nearest 0.1 kg) using a calibrated electronic scale equipped with a mounted stadiometer that measured height to the nearest 0.1 cm (SECA Hamburg,

Germany). Body mass index (BMI) was calculated as body mass in kilograms divided by height in meters squared. The WHO cut-offs were used to classify subjects as overweight (25.0-29.9 kg/m^2) or obese (30.0 kg/m^2)[150]. Waist and hip circumference were measured using a flexible non stretch nylon tape measure (SECA Hamburg, Germany) with participants wearing light clothing. Waist circumference was measured midway between the lower rib margin and the top of the iliac crest at the end of a gentle expiration to the nearest 0.1 cm. Hip circumference was measured at the point of maximal protrusion of the gluteal muscles also to the nearest 0.1 cm. Waist circumference (WC) ≥94.0 cm and waist-to-hip ratio (WHR; waist in cm/hip circumference in cm) ≥0.90 was used to define central obesity [151].

2.4 Physical Activity Measurement

Information on physical activity was obtained using the International Physical Activity Questionnaire (IPAQ-short version; 19) which measures the frequency (days per week), and duration (minutes per day) of moderate- and vigorous-intensity physical activity, in bouts of at least 10 minutes during the past seven-day period in all contexts of daily life. Measurement of PA identified proportion of participants reporting physical activity that would classify them as achieving the current public health recommendations (i.e. all healthy adults aged 18 to 65 years need moderate-intensity aerobic (endurance) physical activity for a minimum of 30 minutes on five days each week or vigorous-intensity aerobic physical activity for a minimum of 20 minutes on three days each week. PA (to classify as physically active) and this definition is based on USA guidelines for physical activity recommended by the Centers for Disease Control and Prevention (CDC) and the American College of Sports

Medicine (ACSM). Participants were then dichotomized into either the ‘active’ or ‘inactive’ (low physical activity level) group [152], [153].

2.5 Data Management and Analysis

Data files were formed in Microsoft Access software. After cleaning and processing, data were imported into SPSS version 21 for analysis. Data are presented as means ± standard deviations if continuous, and as counts and percentages if categorical along with their 95% confidence intervals, which were calculated for descriptive purposes. Chi square, Kruskal Wallis test and Student’s t tests were used to examine differences between groups. Logistic regression analysis was used to evaluate the association of each independent variable on the main outcome measure (inactive versus active, meeting the moderate and vigorous activity guidelines), to estimate crude odds ratios and 95% CIs for each independent variable. A two-tailed alpha with $P<0.05$ was considered statistically significant. Descriptive analysis for both socio-demographic and anthropometric characteristics was conducted by physical activity (inactive, active) and Walking Categories. In multivariable analysis, the study first examined the association between physical activity and socio-demographics non-communicable diseases risk factors, entered one by one. Independent variables that were statistically significant in univariable analyses were selected for examination in multivariable logistic regression analysis to identify independent correlates of low physical activity. Finally, multiple logistic regressions were used to produce odds ratios and 95% CIs, adjusted for those variables that were found to be significant in the binary logistic regression analysis. A p-value of less than 0.05 was considered to be significant.

Chapter 3: Results

3.1 Males

Demographic and Socio-economic Characteristics

Out of 1800 eligible participants 1375 participated, (76.4% response rate), participants were classified into three groups based on their Ethnicity (Indian, Pakistani and Bangladesh). Table 1 shows baseline characteristics and lifestyle characteristics of ethnic groups. Participants were mainly from India, 433 (31.5%), Pakistan 383 (27.9%) and Bangladesh 559 (40.7%). Mean age for participants was 34.0 (±9.925) with the highest age group less than 35 years old (61%) Bangladeshi reported the highest proportion of age group 15-35 while Indians reported the highest proportion of ≥46 age groups. Nearly half of the participants' education level is college / university level. Indians reported the highest level of university education (44.3%), while Pakistani represent the lowest level of education. More than two thirds of the participants are married. Majority of the singles were from Bangladesh, while majority of the married were from India. The majority of the study sample came from urban areas (68.6%). Pakistani's were more likely to come from rural area whereas Bangladeshi were more likely to come from urban area. The mean monthly income AED was 1828.15 (±2130) ranging from 500 to 35,000 AED. Bangladeshi participants' income falls mainly in the lower and middle tertile. Participants were classified into different grouped according to period of residency in UAE. Forty four point nine percent (44.9%) of participants resided in UAE for less than 5 years. Most of Bangladeshi resided in UAE for less than 5 years. Type of residency in UAE was reported to be mainly sharing with non-relatives (52.2%). Most of participants had occupations such as laborers, drivers, construction or agricultural workers. Indian were

more likely to work as professional office worker or salespersons. Bangladeshis' were more likely to work as laborers construction or agricultural workers, while Pakistani were more likely to be drivers or agricultural workers.

Table 1: Characteristics of male South Asian Migrants (n=1375) in Al Ain, United Arab Emirates.

Characteristics	Total n (%)	India n (%)	Pakistan n (%)	Bangladesh n (%)	p-value
Nationality	1375 (100)	433 (31.5)	383 (27.9)	559 (40.7)	<0.001
Age -mean (SD)	34.0 (±9.9)	36.3 (±10.2)	34.8 (±10.7)	31.7 (±8.5)	<0.001
Age, years					<0.001
18-35	793 (61)	208 (25.7)	221(27.3)	381 (47)	
36-45	306 (23.6)	116 (37.8)	77 (25.1)	114 (37.1)	
>=46	200 (15.4)	85 (42.5)	72 (36)	43 (3.3)	
Education					<0.001
None	173 (12.6)	13 (7.5)	90 (52)	70 (40.5)	
High school	473 (34.5)	99 (20.9)	119 (25.2)	255 (53.9)	
College or University	725 (52.9)	321 (44.3)	172 (23.7)	232 (32.0)	
Marital Status					<0.001
Single	412(30)	96 (23.3)	93 (22.6)	223 (54.1)	
Married	963 (70)	337 (35)	290 (30.1)	336 (34.9)	
Home country setting					
Rural	426(31.4)	157 (36.9)	166 (39)	103 (24.2)	<0.001
Urban	932(68.6)	273 (29.3)	206 (22.1)	453 (48.6)	
Income (AED)					
Mean (SD)	1828.15(±2130)	2213(±2823)	2107(±1981)	1349(±1394)	<0.001
Median (IQR)	1200 (1100)	1500(900)	1500(1500)	1000(760)	
Income (AED)					
Lowest tertile	371 (27.0)	58 (15.6)	66 (17.8)	247 (66.6)	<0.001
Middle tertile	290 (21.1)	86 (29.7)	81 (27.9)	123 (42.4)	
Highest tertile	714 (51.9)	289 (40.5)	236 (33.1)	189 (26.5)	
Years in United Arab Emirates					<0.001
<5 Years	547 (44.9)	169 (30.9)	140 (25.6)	238 (43.5)	
5-10 years	257 (21.0)	88 (34.2)	59 (23)	110 (42.8)	
>10 years	414 (34.1)	144 (34.8)	139 (33.6)	131 (31.6)	
Type of accommodation					<0.001
At a labor camp	168(12.2)	45 (26.8)	58 (34.5)	65 (38.7)	

Table 1: Characteristics of male South Asian Migrants (n=1375) in Al Ain, United Arab Emirates (Continued).

Characteristics	Total n (%)	India n (%)	Pakistan n (%)	Bangladesh n (%)	p-value
Living with Sponsor	184(13.4)	56 (30.4)	62 (33.7)	66 (35.9)	
Single accommodation	153(11.1)	60 (39.2)	43 (28.1)	50 (32.7)	
Shared with relatives	152(11.1)	52 (34.2)	57 (37.5)	43 (28.3)	
Shared with non-relatives	717(52.2)	220 (30.7)	163 (22.7)	334 (46.6)	
Occupation					<0.001
Driver	317(23.1)	89 (28.1)	123 (38.8)	105 (33.1)	
Laborer	234(17)	64 (27.4)	57 (24.4)	113 (48.3)	
Construction worker	172 (12.5)	58 (33.7)	35 (20.3)	79 (45.9)	
Agriculture worker	236(17.2)	34 (14.4)	91 (38.6)	111 (47.0)	
Professional office worker	95(6.9)	48 (50.5)	27 (28.4)	20 (21.1)	
Salesperson	79(5.7)	50 (63.3)	11 (13.9)	18 (22.8)	
Business shop keeper	60(4.4)	24 (40)	15 (25)	21 (35)	
Hospitality worker	71(5.2)	34 (47.9)	3 (4.2)	34 (47.9)	
Tailor	70(5.1)	18 (25.7)	9 (12.9)	43 (61.4)	
Other	40(2.9)	14 (35)	12 (30)	14 (35)	

Physical Activity by Nationality

The prevalence of physical activity in South Asian 34.7%; 95% Confidence Interval (32.3-37.3). Results showed that there is a significant difference between ethnics in terms of their PA level (P <0.001). Bangladeshi (42.5%) reported significantly higher physical activity compared to Indians and Pakistani. There was a significant differences in PA by education level in Bangladeshi ethnic groups (p 0.003). Participants from Bangladeshi rural home country setting were more active. PA was more prevalent in Bangladeshi participants who fall into the lowest tertiles of the income. Indian participants level of PA decreases significantly with longer years in UAE (P >0.019).

Higher level of PA was reported in Indian participants living with non-relatives and Pakistani participants who live with sponsor. Indian and Bangladeshi most active

professions were laborers, agricultural workers and construction workers. Pakistani most active professions were salesperson, tailors and hospitality workers. Table 2 shows PA stratified by nationalities.

Table 2: Distribution of Physical activity by sociodemographic characteristics of male South Asian migrants (n=1375), Al Ain, United Arab Emirates.

Characteristics	India			Pakistan			Bangladesh		
	Active n (%)			Active n (%)			Active n (%)		
Active	No	Yes	p-value	No	Yes	p-value	No	Yes	p-value
All	304 (71.4)	122 (28.6)		263 (69.7)	114 (30.3)		316 (57.5)	234 (42.5)	<0.001
18-35	137 (67.2)	67 (32.8)	0.100	148 (68.8)	67 (31.2)	0.680	207 (55.3)	167 (44.7)	0.260
36-45	90 (77.6)	26 (22.4)		56 (73.7)	20 (26.3)		72 (63.2)	42 (36.8)	
>=46	64 (75.3)	21 (24.7)		52 (72.2)	20 (27.8)		27 (62.8)	16 (37.2)	
Education									
None	7 (53.8)	6 (46.2)	0.230	66 (74.2)	23 (25.8)	0.410	31 (44.3)	39 (55.7)	0.003
High school	66 (68.1)	31 (31.9)		78 (65.5)	41 (34.5)		135 (54.0)	115 (46.0)	
College or University	231 (73.1)	85 (26.9)		116 (69.9)	50 (30.1)		148 (64.9)	80 (35.1)	
Marital Status									
Single	61 (65.6)	32 (34.4)	0.164	59 (65.6)	31 (34.4)	0.329	126 (57.5)	93 (42.5)	0.975
Married	243 (72.8)	90 (27.1)		203 (70.9)	83 (29.1)		190 (57.4)	141 (42.6)	
Home country setting									
Rural	184 (68.7)	84 (31.3)	0.135	137 (67.5)	66 (32.5)	0.397	243 (54.6)	202 (45.4)	0.003
Urban	117 (75.5)	38 (24.5)		116 (71.6)	46 (28.4)		72 (70.6)	30 (29.4)	
Income (AED)									
Lowest tertile	35 (60.3)	23 (39.7)	0.078	38 (58.5)	27 (41.5)	0.096	108 (44.1)	137 (55.9)	
Middle tertile	66 (77.6)	19 (22.4)		58 (71.6)	23 (28.4)		81 (67.5)	39 (32.5)	
Highest tertile	203 (71.7)	80 (28.3)		166 (72.2)	64 (27.8)		127 (68.6)	58 (31.4)	<0.001

Table 2: Distribution of Physical activity by sociodemographic characteristics of male South Asian migrants (n=1375), Al Ain, United Arab Emirates (Continued).

Characteristics	India			Pakistan			Bangladesh		
	Active n (%)			Active n (%)			Active n (%)		
	No	Yes	p-value	No	Yes	p-value	No	Yes	p-value
UAE Years of residence									
<5 Years	116 (69.1)	52 (30.9)	0.019	92 (67.1)	45 (32.9)	0.282	130 (55.6)	104 (44.4)	
5-10 years	54 (63.5)	31 (36.5)		41 (69.5)	18 (30.5)		66 (61.1)	42 (38.9)	
>10 years	114 (78.7)	29 (20.3)		103 (75.7)	33 (24.3)		80 (61.1)	51 (38.9)	0.457
Accommodation									
In a labor camp	155 (72.1)	60 (27.9)	0.019	99 (61.5)	62 (38.5)	0.016	189 (57.6)	139 (42.4)	0.119
Living with Sponsor	32 (62.7	19 (37.3)		45 (81.8)	10 (18.2)		23 (53.5)	20 (46.5)	
Single accommodation	47 (78.3)	13 (21.7)		31 (72.1)	12 (27.9)		31 (62.0)	19 (38.0)	
With relatives	45 (81.8)	10 (18.2)		48 (80.0)	12 (20.0)		44 (67.7)	21 (32.3)	
With non-relatives	25 (55.6)	20 (44.4)		39 (68.4)	18 (31.6)		29 (45.3)	35 (54.7)	
Occupation									
Driver	73 (83.9)	14 (16.1)	0.002	92 (77.3)	27 (22.7)	0.011	80 (77.7)	23 (22.3)	<0.001
Laborer	37 (59.7)	25 (40.3)		40 (70.2)	17 (29.8)		48 (42.9)	64 (57.1)	
Construction worker	36 (62.1)	22 (37.9)		26 (74.3)	9 (25.7)		34 (43.1)	45 (56.9)	
Agriculture worker	16 (50.0)	16 (50.0)		51 (56.7)	39 (43.3)		48 (43.6)	62 (56.4)	
Professional worker	34 (70.8)	14 (29.2)		18 (72.0)	7 (28.0)		14 (70.0)	3 (17.6)	
Salesperson	36 (73.5)	13 (26.5)		5 (45.4)	6 (54.6)		14 (82.3)	3 (17.7)	
Business shop keeper	18 (75.0)	6 (25.0)		14 (93.3)	1 (6.7)		14 (66.7)	7 (33.3)	
Hospitality worker	27 (79.4)	7 (20.6)			3 (100)		18 (54.5)	15 (45.5)	
Tailor	17 (94.4)	1 (5.6)		2 (22.2)	7 (77.8)		40 (95.2)	2 (4.8)	
Other	10 (71.4)	4 (28.6)		6 (50.0)	6 (50.0)		6 (46.2)	7 (53.8)	

Table 3 reports the prevalence of physical activity Among Male South East Asian Migrants in Al Ain, Abu Dhabi. Based on the USA guidelines for physical

activity recommended by the Centers for Disease Control and Prevention (CDC) and the American College of Sports Medicine (ACSM), Physical activity prevalence was 34.8%. Physically active participants tend to be younger and physical activity decreases with age. Physical inactivity increases with higher education level. Single males were more likely to be active (38.8% vs. 33.1%). Participants coming from urban home setting reported lower physical activity compared with Rural (27.2% versus 38.4%). Physically active participants had lower income/month. Approximately 50% of participants in the lowest tertiles of monthly income were active compared to 28% for middle and higher tertiles. Physical activity was higher among participants spending <5 years in UAE (37.3%), while physical inactivity was higher among participants residing in UAE for more than 10 years (72.4%). Highest level of physical activity was reported among participants living in shared accommodation with non-relatives or in Labor camp. Furthermore, agricultural worker, construction workers and laborers were the highest active profession.

Table 3: Physical activity levels across socio-demographic characteristics of the male South Asian migrants in Al Ain, United Arab Emirates.

Characteristics	Proportion reporting moderate/vigorous physical activity		
	No n (%)	Yes n (%)	p-value
All	882 (65.2)	470 (34.8)	0.003
18-35	492 (62.1)	301 (37.9)	
36-45	218 (71.2)	88 (28.8)	
>=46	143 (71.5)	57 (28.5)	
Education			
None	104 (60.5)	68 (39.5)	<0.001
High school	279 (59.9)	187 (40.1)	

Table 3: Physical activity levels across socio-demographic characteristics of the male South Asian migrants in Al Ain, United Arab Emirates (Continued).

Characteristics	Proportion reporting moderate/vigorous physical activity		
	No n (%)	Yes n (%)	p-value
Education			
College or University	495 (69.7)	215 (30.3)	
Marital Status			
Single	246 (61.2)	156 (38.8)	0.042
Married	636 (66.9)	314 (33.1)	
Home country setting			
Rural	564 (61.6)	352 (38.4)	<0.001
Urban	305 (72.8)	114 (27.2)	
Income (AED)			
Lowest tertile	181 (49.2)	187 (50.8)	
Middle tertile	205 (71.7)	81 (28.3)	
Highest tertile	496 (71.1)	202 (28.9)	<0.001
Years in United Arab Emirates			
<5 Years	338 (62.7)	201 (37.3)	0.005
5-10 years	161 (63.9)	91 (36.1)	
>10 years	297 (72.4)	113 (27.6)	
Type of accommodation			
At a labor camp	443 (62.9)	261 (37.1)	<0.001
Living with Sponsor	100 (67.1)	49 (32.9)	
Single accommodation	109 (71.2)	44 (28.8)	
Shared with relatives	137 (76.1)	43 (23.9)	
Shared with non-relatives	93 (56.1)	73 (43.9)	
Occupation			
Driver	245 (79.3)	64 (20.7)	<0.001
Laborer	125 (54.1)	106 (45.9)	
Construction worker	96 (55.8)	76 (44.2)	
Agriculture worker	115 (49.6)	117 (50.4)	
Professional office worker	66 (71.0)	27 (29.0)	
Salesperson	55 (71.4)	22 (28.6)	
Business shop keeper	110 (85.3)	19 (14.7)	
Hospitality worker	48 (68.6)	22 (31.4)	
Other	22 (56.4)	17 (43.6)	

Table 4 reports the prevalence of physical activity by behavioral/lifestyle and cardiovascular risk factor in male migrants. The prevalence of physical activity was higher in participants with normal BMI (41.5%) compared to obese participants (26.0%). Among participants with abdominal obesity 75.5% were physically inactive whereas, 24.5% were physically active. Diabetes prevalence was 3 times higher in non-active participants (75.9%) compared to active participants (24.1%).

Table 4: Physical activity levels by non-communicable disease risk factors in male South Asian migrants (n=1375), Al Ain, United Arab Emirates.

Characteristics (non-communicable disease risk factors)	Moderate/vigorous physical activity		
	No	Yes	p value
	n (%)	n (%)	
Body mass index (kg/m^2) category			
Normal weight (18.5-24.9)	306 (58.5)	217 (41.5)	<0.001
Overweight (25.0-29.9)	352 (66.9)	174 (33.1)	
Obese (≥30.0)	222 (74.0)	78 (26.0)	
Central obesity			
No	546 (60.2)	361 (39.8)	<0.001
Yes	336 (75.5)	109 (24.5)	
Cigarette smoking status			
Never	531 (65.6)	278 (34.4)	0.494
Former	234 (63.1)	137 (36.9)	
Current	117 (68.0)	55 (32.0)	
Alcohol use			
No	79 (61.7)	49 (38.3)	0.559
Yes	709 (64.3)	393 (35.7)	
Hypertension status			
<140/90 mmHg	597 (63.7)	341 (36.3)	0.065
≥140/90 mmHg or on medication	285 (68.8)	129 (31.2)	
Diabetes mellitus			
No	797 (64.3)	443 (35.7)	
Yes	85 (75.9)	27 (24.1)	0.013

Multiple regression analysis was used to explore factors predicting physical activity.

Table 5 shows results of the multivariable logistic regression analysis examining the relationship between PA and socio-demographic characteristics. Variables that were found to be significant using univariable binary regression included: age, education, marital Status, home country setting, monthly income, years lived in UAE, accommodation, occupational category, and nationality. There was an association between nationalities of participants with physical activity. Pakistani and Indians participants were less likely to be active. The prevalence of physical activity was lowest among urban participants. Participants living at labor camp, with sponsor or with shared non-relatives were more active. Overall drivers, business shopkeeper and hospitality workers showed low levels of physical activity whereas; agricultural workers were more likely to be active. The study analysis did not find any significant interaction between duration of residency and physical activity.

Table 5: Low level of physical activity and its association with socio-demographic variables in male South Asian migrants: Multivariable logistic regression analysis.

Socio-demographic variables	Low physical activity* Adjusted OR (95% CI)	p-value
Age in years	1.01 (0.98 - 1.02)	0.596
Monthly salary	1.00 (0.99-1.00)	0.418
Education		
High school versus none	0.84 (0.54 - 1.31)	0.438
College or University	0.90 (0.56 - 1.43)	0.659
Urban Vs. rural	1.59 (1.16-2.19)	0.004
Years in United Arab Emirates		
5-10 years Vs. <5 years	0.97 (0.67 - 1.38)	0.869
>10 years	1.19 (0.78 - 1.79)	0.415
Type of accommodation		
At a labor camp	0.59 (0.37 - 0.93)	0.023
Living with Sponsor	0.35 (0.19 - 0.66)	<0.001
Single accommodation	0.68 (0.37 - 1.23)	0.205
Shared with relatives	Ref.	
Shared with non-relatives	0.53 (0.31 - 0.92)	0.024

Table 5: Low level of physical activity and its association with socio-demographic variables in male South Asian migrants: Multivariable logistic regression analysis (Continued).

Socio-demographic variables	Low physical activity* Adjusted OR (95% CI)	p-value
Occupation		
Driver	2.64 (1.69 - 4.11)	<0.001
Laborer	Ref.	
Construction worker	1.02 (0.64 - 1.63)	0.925
Agriculture worker	0.64 (0.42 - 0.99)	0.046
Professional office worker	1.52 (0.79 - 2.89)	0.204
Business shop keeper	4.27 (2.18 - 8.34)	<0.001
Salesperson	1.85 (0.94 - 3.65)	0.073
Hospitality worker	2.09 (1.04 - 4.21)	0.037
Other	1.06 (1.04 -4.21)	0.882
Nationality		
India	1.49 (1.06 - 2.11)	0.019
Pakistan	1.65 (1.15 - 2.37)	0.006
Bangladesh	Ref.	

*Moderate physical activity <30 minutes on five days or vigorous physical activity for less the 20 minutes on three days each week (Ref. 150, 151).

Table 6 shows results of the multivariable logistic regression analysis examining the relationship between PA and selected cardiovascular risk factors. Variables that were found to be significant using univariable binary regression included BMI categories, abdominal obesity, cholesterol and diabetes. In multivariable analysis, factors including central obesity, cholesterol were independently and significantly associated with physical activity. Those who reported low levels of physical activity had 1.34 (1.01-1.79) times the odds (95% CI) of having central obesity. Nationality was still significantly associated with PA after even after adjustment (Indians AOR, 1.60 95% CI: 1.18-2.16 and Pakistani AOR, 1.68 95% CI: 1.23-2.29).

Table 6: Low Physical activity level and its relation with non-communicable disease risk factors in male South Asian migrants (n=1375), Al Ain, United Arab Emirates

NCDs risk factors	Low physical activity*	
	Adjusted OR (95% CI)	p value
Body mass index (kg/m2)	1.01 (0.98 - 1.04)	0.47
Central obesity		
No	Ref	
Yes	1.34 (1.01 - 1.79)	0.044
Cigarette smoking		
No	Ref.	
Yes	0.88 (0.66 - 1.14)	0.341
High cholesterol		
No	Ref	
Yes	2.35 (1.25 - 4.45)	0.008
Hypertension status, BP>140/90 mmHg/medication		
No	Ref.	
Yes	0.95 (0.72 - 1.26)	0.752
Diabetes mellitus		
No	Ref.	
Yes	1.13 (0.68 - 1.87)	0.363
Nationality		
India	1.60 (1.18 - 2.16)	0.002
Pakistan	1.68 (1.23 - 2.29)	<0.001
Bangladesh	Ref.	
Age in years	1.00 (0.98 - 1.01)	0.928

*Moderate physical activity <30 minutes on five days or vigorous physical activity for less the 20 minutes on three days each week (Ref. 150, 151).

3.1.1 Discussion - Male

In a sample of male South Asian migrants in UAE, physical activity prevalence was (34.8%). Results showed significant differences in physical activity among Migrants based on ethnicity, home country setting, accommodation, occupations, central obesity and cholesterol. Based on literature review, this is the first study on the association between the Physical activity and selected health outcomes among male South Asian migrants in the UAE or other Gulf countries.

Previous research work confirmed that South Asians are not physically active compared with the indigenous populations of the host country (118, 154–156). This study results support earlier literature highlighting low levels of exercise among South Asians [157]. In this study, the prevalence of PA was 34.2% which is somewhat higher compared to reported prevalence globally (31.1%) [1], A study done in UK concluded that 71 % of Indians, 88 % of Pakistanis and 87% of Bangladeshis were inactive. [137]. Similar results that Bangladeshi males have the highest proportion of PA was reported in a cross sectional study in UK [158]. Another integrative review reported low PA level 40% among South Asian [159]. The literature exploring the PA among South Asians were directed toward migrant populations living in developed Western countries. Studies exploring South Asian PA reported lower level compared to Europeans [160]–[162] and Americans [163].

This study confirms that urbanization is associated with physical activity [131], [164]. This study supports previous studies which noted that PA was highest among rural participants and lowest in migrants males [165]–[167]. This result is consistent with previous study which found a difference in physical activity that is almost18 times higher in the urban group compared to the rural group [168]. Furthermore, rural men in India were reported to be more physically active compared with urban men [169], [170]. A systematic review reported a similar results that south Asians inactivity prevalence is higher in urban areas compared to rural areas [171].

This study confirmed the previous literature regarding higher levels of cholesterol in south Asian population [172]. Evidence support this study finding that higher level of cholesterol are associated with inactivity [82], [172]–[174]. These findings are consistent with and support previous data from other studies confirming PA is negatively correlated with cholesterol level in South Asian [143], [175]. A study

in UK reported a significant associations between PA levels and cholesterol in south Asian men [162]. However, other studies reported that no association between PA and cholesterol [137], [176].

This study outcomes confirmed previous literature highlighting the association between PA with central obesity [137], [177], [178]. A randomized control trial demonstrated a strong dose-response relationship between the PA and central obesity [179]. This study results are significant although lower cut-offs of abdominal obesity for South Asians are advocated to prevent NCDs [8], [82]. Acculturation study utilization the same sample found that living in UAE for more than 5 years was significantly associated with central obesity [20]. In this study living in UAE for more than 5 years decreases the PA levels.

A key finding of this study is a statistically significant differences in PA across different occupations. The results support previous literature that Un-skilled workers seem to be more active than skilled workers and drivers [97], [101], [104], [105], [178], [180]. The results of the study are comparable with another systematic review which informed that those working as blue collar lower-status occupations proved higher PA than professionals [181]. A study looking into acculturation utilizing same expatriate sample found that vigorous and moderate PA was particularly low and central obesity was high among migrants working in sedentary occupations such as drivers, shop keepers and tailors [20].

Participants living at a labor camp, with sponsor or in shared with non-relatives were found to be more involved in PA. Those housing type represent participants of lower socioeconomic status. Studies reported higher PA levels among those with lower socioeconomic status as this may increase chances of energy expenditure [181]–[183].

Similar to this study a cross sectional study reported that urban setting and low income were predictors of PA [183].

3.1.2 Conclusion

In conclusion, physical activity was low across male South Asian migrants from India, Pakistan and Bangladesh in UAE. Male migrants working as driver, shopkeeper or in business, and in hospitality were more likely to be physically inactive. Male migrants working in agriculture were less likely to be physically in active. Male migrants from Pakistan and India were more likely to be physically inactive as compared to their counterparts from Bangladesh. Male migrants who came from cities (urban) were also more likely to be physically inactive compared those who came from rural areas. Male migrants living in labor camps, with a sponsor, and sharing accommodation with non-relatives were less likely to be physically inactive. Those with reported low physical activity were more likely to have high cholesterol levels and abdominal (central) obesity after adjusting for nationality and age. These findings helped to identify vulnerable population in order to target interventions to improve physical activity.

3.2 Female

Demographic and Socio-economic Characteristics

Of the 800 eligible participants, 599 (75% participation rate) agreed to participate. The participant where mainly from three geographical areas: the Philippines, Arab countries and South Asia. The mean age was 34.1 ± 9.6 years. Arabs females were reported to be older with a mean age of 36.6 ± 11.1. Most of the study participants' age was below 44 years. The mean monthly salary was 3093.64 ± 4202.36 AED. Arab females reported the highest mean monthly income while Philipinos reported the lowest. More than half of the participants (55.6%) reported to have college or higher education. Job categories varied for the group. Participants were either domestic workers (36.6%) or housewives (23.3%). Participants from Philippines were mostly domestic workers, while Arab and south Asian participants were mostly housewives. A total of 52.8 % of participants where from urban area and 61.2% were married. Majority of South Asians and Arabs were married. More than half of participants (61.2%) were living in UAE for more than 5 years. More than two third of Arab and South Asian females were in UAE for more than 5 years. Arab females were reported to have the highest mean height 159.0±8.4, weight 73.1±17.7 and BMI 29.0±7.4, while Philippines reported the lowest. Arabs and south Asians reported higher percentage of diabetes family history. Cigarettes smoking was reported mainly in Arab's (10.7%) and Philippines' (7.6%). Participants from Philippines reported higher walking for at least 30 minutes in a day (30%) compared to Arab's (13.5%) and south Asians (19.3%). Moreover, they reported more MVPA (45.9%) compared to Arab's (11.1%) and south Asians (10.2%). Abnormal HbA1C level was mainly reported in south Asians (16.7%). With respect to accommodation arrangements, 43.8% lived in shared accommodation with relatives, 35.4% lived with their sponsor

(employer), 11.1% shared accommodation with non-relatives and 9.4% had single accommodation. Table 2.1 shows demographic and socio-economic characteristics of the study participants based on nationality.

Table 7: Characteristics of Female Migrants (n=555) in Al Ain, United Arab Emirates, 2014.

Characteristics	All	Nationality			p-value
		Philipinos	Arabs	South Asians	
		n (%)	n (%)	n (%)	
All	555	292 (52.6)	136 (24.5)	127 (22.9)	
Age, yr, mean, ± (SD)	34.1 ± 9.6	33.1 ± 8.4	36.6 ± 11.1	33.6 ± 9.6	0.005
Monthly earning, mean, ±	3090.6 (4202.3)	1914.7 ± 2743.4	7350.0 ± 6440.9	5677.2 ± 4769.3	<0.001
Education level					
Primary	39 (7.2)	15 (5.2)	15 (11.2)	9 (7.3)	
Secondary	203 (37.2)	124 (43.2)	40 (29.8)	39 (31.4)	0.016
College or University	303 (55.6)	148 (51.6)	79 (60.0)	76 (61.3)	
Occupation, %					
Housemaid	192 (36.6)	176 (63.5)	8 (6.2)	8 (6.8)	
Housewife	122 (23.3)	4 (1.5)	64 (49.6)	54 (45.8)	<0.001
Professional	119 (22.7)	28 (10.1	29 (22.5)	34 (28.8)	
Administrator, supervisor	91 (17.4)	69 (24.9)	28 (21.7)	22 (18.6)	
Marital status, married	306 (61.2)	118 (46.3)	89 (72.4)	99 (81.1)	<0.001
Country home setting, rural	235 (47.2)	125 (49.2)	71 (56.8)	39 (32.8)	<0.001
Years in UAE, %					
<5 years	186 (38.8)	134 (53.2)	27 (22.9)	25 (22.9)	<0.001
≥5 years	293 (61.2)	118 (46.8)	91 (77.1)	84 (77.1)	
Height, cm, ± (SD)	155.6 ± 6.7	153.3 ± 5.3	159.0 ± 8.4	157.3 ± 5.7	<0.001
Weight, cm, ± (SD)	62.3 ± 14.9	56.6 ± 10.8	73.1 ± 17.7	64.2 ± 13.2	<0.001
Waist, cm, ± (SD)	85.9 ± 13.4	80.0 ± 10.0	92.1 ± 15.1	92.0 ± 12.1	<0.001
Hip, cm, ± (SD)	97.9 ± 12.7	93.5 ± 9.8	105.4 ± 16.0	100.3 ± 10.1	<0.001
Waist-to-hip ratio, ± (SD)	0.88 ± 0.1	0.86 ± 0.1	0.88 ± 0.1	0.92 ± 0.1	<0.001
Body mass index, kg/m, ± (SD)	25.7 ± 5.7	24.0 ± 4.1	29.0 ± 7.4	26.0 ± 5.5	<0.001
Systolic BP, mm Hg, ± (SD)	118.9 ± 18.4	119.6 ± 16.9	117.5 ± 18.7	118.7 ± 22.0	0.748
Diastolic BP, mm Hg, ± (SD)	75.8 ± 12.6	76.4 ± 11.3	74.0 ± 11.5	76.5 ± 16.4	0.301
Family history of diabetes, %	148 (26.2)	37 (13.3)	52 (40.3)	51 (41.5)	<0.001
Family history of hypertension, %	171 (29.9)	77 (27.6)	48 (36.6)	37 (29.8)	0.252

Table 7: Characteristics of Female Migrants (n=555) in Al Ain, United Arab Emirates, 2014 (Continued).

Characteristics	All	Nationality			p-value
		Philipinos	Arabs	South Asians	
		n (%)	n (%)	n (%)	
	555	292 (52.6)	136 (24.5)	127 (22.9)	
Smoke cigarette, currently, %	39 (7.1)	22 (7.6)	14 (10.3)	3 (2.4)	0.037
Walk for at least 30 minutes in a day, %	101 (24.1)	66 (30.0)	10 (13.5)	16 (19.3)	0.021
Moderate/Vigorous physical activity, %	161 (29.1)	133 (45.9)	15 (11.1)	13 (10.2)	<0.001
Reported history of high cholesterol, %	33 (6.6)	9 (3.5)	13 (10.7)	11 (9.5)	0.011
HbA1C level, %					<0.001
<5.7%	157 (68.9)	53 (89.8)	63 (70.0)	35 (53.0)	
5.7 to 6.4%	46 (20.2)	5 (8.5)	15 (16.7)	20 (30.3)	
≥6.5%	25 (10.9)	1 (1.7)	12 (13.3)	11 (16.7)	

Physical Activity and selected health outcomes

Table 8 reports the prevalence of physical activity among female migrants in Al Ain, Abu Dhabi. Based on the USA guidelines for physical activity recommended by the Centers for Disease Control and Prevention (CDC) and the American College of Sports Medicine (ACSM). Prevalence of PA was 10.2% (95% CI: 5.9-16.9) for South Asians, 11.0% (95% CI: 6.7-17.6) for Arab females and 45.9% (95% CI: 40.2-51.7) for Philippine females. A total of 29.1% of participant were active while 392 participants (70.9%) were physically inactive. Compared with South Asians (10.2%) and Arabs (11%) more than half of the Filipino participants were active (45.9%). Inactive participants reported more college or higher education. A total of 76.8% of the inactive participants were married and 37.1% of single participants were physically active. More than half of participants (54.1%) who fall in lower income tertiles were active and physical activity decreased with increasing income. Physical inactivity increased with longer duration of stay in UAE. Regarding accommodation, most active participants lived with Sponsor. Shared accommodation with relatives

was predictive of the highest physical inactivity levels. The most active participants were domestic workers (53.1%), whereas housewives were the highest inactive participants.

Table 8: Physical activity levels across socio-demographic characteristics among female migrants, Al Ain, United Arab Emirates.

Characteristics	Reported moderate / vigorous physical activity		
	No n (%)	Yes n (%)	p-value
All	392 (70.9)	161 (29.1)	
Age, %			
18-30 y	136 (73.1)	50 (26.9)	0.231
31-40 y	111 (64.9)	60 (35.1)	
≥41 y	141 (73.8)	50 (26.2)	
Education, %			
Primary	30 (76.9)	9 (23.1)	0.026
Secondary	130 (64.0)	73 (36.0)	
College or University	226 (74.6)	77 (25.4)	
Occupation, %			
Housemaid	90 (46.9)	102 (53.1)	<0.001
Housewife	110 (90.2)	12 (9.8)	
Professional	74 (81.3)	17 (18.7)	
Administrator, supervisor	95 (79.8)	24 (20.2)	
Nationality			
South Asian	114 (89.8)	13 (10.2)	<0.001
Arab	121 (89.0)	15 (11.0)	
Philippines	157 (54.1)	133 (45.9)	
Home country setting			
Rural	162 (68.9)	73 (31.1)	0.876
Urban	183 (69.6)	80 (30.4)	
Marital status			
Single	122 (62.9)	72 (37.1)	<0.001
Married	235 (76.8)	71 (23.2)	

Table 8: Physical activity levels across socio-demographic characteristics among female migrants, Al Ain, United Arab Emirates (Continued).

Characteristics	Reported moderate / vigorous physical activity		
	No	Yes	
	n (%)	n (%)	p-value
Accommodation in UAE			
With family	198 (84.6)	36 (15.4)	<0.001
With sponsor	94 (50.5)	92 (49.5)	
Single	35 (70.0)	15 (30.0)	
With non-relatives	47 (77.1)	14 (22.9)	
Monthly income, AED, %			
Lowest tertile	61 (45.9)	72 (54.1)	
Middle Tertile	54 (63.5)	31 (36.5)	
Highest tertile	83 (79.8)	21 (20.2)	<0.001
Duration of residence in UAE			
<5 years	110 (59.5)	75 (40.5)	
≥5 years	223 (76.1)	70 (23.9)	<0.001

Table 9 reports the prevalence of physical activity by behavioral/lifestyle and cardiovascular risk factor in female migrants. Physical activity decreased with increasing BMI. A total of 23.4% of participants who were active had abdominal obesity, while approximately 76.6% of inactive participants had abdominal obesity. In addition, 24.2% of participants diagnosed with hypertension were active while 75.8% were inactive. Of the participants with diabetes 14.3% were active, while 85.7% were inactive. Only 18.2% of active participants had high cholesterol. Forty seven point six percent (47.6%) of participant who reported drink Alcohol were active, whereas 52.4% where inactive. Forty three point six percent (43.6%) smoking participants were active, whereas 28.1% of nonsmoker were active.

Table 9: Physical activity levels by non-communicable disease risk factors in female migrants in Al Ain, United Arab Emirates.

Characteristics	Reported moderate / vigorous physical activity		
	No	Yes	
	n (%)	n (%)	p value
All	392 (70.9)	161 (29.1)	
BMI (Kg/m^2) categories			
<25.0	202 (68.7)	92 (31.3)	0.125
25-29.9	116 (69.9)	50 (30.1)	
BMI≥30.0	74 (79.6)	19 (20.4)	
Central obesity			
No	183 (65.4)	97 (34.6)	0.004
Yes	209 (76.6)	64 (23.4)	
Hypertension (BP≥140/90 mmHg) or medication			
No	319 (69.8)	138 (30.2)	0.234
Yes	72 (75.8)	23 (24.2)	
Diabetes			
No (HbA1c <5.7%)	99 (70.2)	42 (29.8)	0.067
Prediabetes (HbA1c 5.7-6.4%)	26 (81.2)	6 (18.7)	
Diabetes (HbA1c ≥6.5%)	42 (85.7)	7 (14.3)	
Family history of diabetes			
No	257 (66.1)	132 (33.9)	0.067
Yes	114 (81.4)	26 (18.6)	
Diagnosed with high cholesterol			
No	320 (68.9)	144 (31.1)	0.120
Yes	27 (81.8)	6 (18.2)	
Current cigarette smoker			
No	370 (71.9)	144 (28.1)	0.039
Yes	22 (56.4)	17 (43.6)	
Alcohol use			
No	337 (75.2)	111 (24.8)	<0.001
Yes	55 (52.4)	50 (47.6)	

Variables that were found to be significant using univariable binary regression included: nationality, education, marital Status, monthly income, years lived in UAE, accommodation, occupational category, income, abdominal obesity, cigarettes smoking and alcohol use. Multivariable binary logistic regression models were

constructed on the significant factors in univariable analysis for outcomes of health and lifestyle. Nationality and accommodation in UAE were significantly associated with physical activity. Participants from Philippines were more active than others (AOR, 0. 08, 95% CI: 0.02-0.34). Living with sponsor (AOR, 0.28, 95% CI: 0.08-0.95) or single accommodation (AOR, 0. 09, 95% CI: 0.02-0.47) was associated with physical activity. In Table 10 results of the multivariable logistic regression analysis examining the relationship between physical activity and selected cardiovascular risk factors are presented.

Table 10: Low physical activity and its associated factors among female migrants, Al Ain, United Arab Emirates: Multivariable logistic regression analysis.

Variables	Low physical activity	
	Adjusted OR (95% CI)	p-value
Age, in years	0.96 (0.93 - 1.01)	0.129
Education		
Primary	Ref.	
Secondary	1.39 (0.32 - 6.06)	0.662
College or University	1.95 (0.44 - 8.69)	0.382
Occupation		
Housewife	Ref.	
Housemaid	O.33 (0.07 - 1.41)	0.134
Professional	1.51 (0.45 - 5.11)	0.508
Administrator, supervisor	0.28 (0.05 - 1.48)	0.136
Nationality		
South Asian	Ref.	
Arab	0.38 (0.15 - 1.59)	0.137
Philippines	0. 08 (0.02 - 0.34)	<0.001
Marital status		
Single	Ref.	
Married	1.25 (0.65 - 2.41)	0.505

Table 10: Low physical activity and its associated factors among female migrants, Al Ain, United Arab Emirates: Multivariable logistic regression analysis (Continued).

variables	Low physical activity	p-value
	Adjusted OR (95% CI)	
Accommodation in UAE		
With family	Ref.	
With sponsor	0.28 (0.08 - 0.95)	0.042
Single	0.09 (0.02 - 0.47)	0.004
With other relatives	0.66 (0.20 - 2.14)	0.495
Monthly salary	1.01 (0.99 - 1.00)	0.814
Central obesity (waist >0.80 cm)	1.58 (0.82 -3.04)	0.167
No	Ref.	
Yes		
Cigarette smoking currently		
No	Ref.	
Yes	0.84 (0.15 -1.75)	0.288
Alcohol use		
No	Ref.	
Yes	0.84 (0.39 - 1.82)	0.667
Duration of residency in UAE		
<5 years	Ref.	
≥5 years	1.62 (0.81 - 3.29)	0.174

3.2.1 Discussion - Female

In a sample of Female expatriates from South Asia, Arab and Philippines, the prevalence of physical activity was 29.1%. PA was significantly high in Philippines migrants. Furthermore, living with sponsor or in single accommodation was predictive of PA. Based on literature search, this is the first study on the association between the physical activity and selected health outcomes among Female migrants in the UAE.

This study reported higher prevalence than international levels. An international study across 168 countries reported overall age-standardized prevalence of physical inactivity in females as 31.7% (95% CI: 28.6-39) [113]. A nationwide study in USA women reported higher physical activity prevalence 54% than the

reported level of this study [184]. A comparable population survey of women in Colombia reported a higher prevalence of physical inactivity 79.1% [185]. A recent systematic assessment of literature regarding physical inactivity in Arab countries addressed higher inactivity prevalence among females [186]. Saudi Arabia reported alarming low prevalence of physical activity among women [187], [188]. Furthermore, a cross-sectional study in Lebanon reported a prevalence of physical activity to be 34% which is higher than this study results [189].

Similar to this study results a study concluded that the lowermost probabilities of being active were for women specially from Asia (OR=0.53) [190]. This study supported the literature of low prevalence of physical activity in south Asians females immigrants [137], [191], [192]. High physical inactivity prevalence among females was even reported in their origin country [170], [193]. A study in UAE utilizing same sample of female migrant's explored prevalence of Type 2 diabetes. Results showed that South Asians females had the highest prevalence of diabetes. Correspondingly in this study south Asian females were reported to be the least active group (Physical activity prevalence 10.2%) [19].

Furthermore, this study reported that Filipino were more active than other migrants. A cross sectional survey in USA reported that Filipino were 42.3% moderately active and 21.9% were highly active [194]. A recent lancet study reporting global trends of insufficient PA reported that Philippines population has one of the highest prevalence countries. This study results of Filipino migrants was 54.1% which is higher than the global trend 39.7%. This is probably due to acculturation in UAE [113].

3.2.2 Conclusion

Physical inactivity is a significant public health problem among migrant women in the UAE. This study shows that a large percentage of expatriate females in UAE are inactive (70.9%). It was clear that Physical inactivity is increasingly becoming prevalent among the UAE female expatriate population. This may be largely due to the result of the recent dramatic changes in the region. The high prevalence in UAE, particularly among females, signifies a major public health problem and an originator for obesity prevalence. Therefore, urgent measures need to be commenced to encourage physical activity to curtail the epidemics of non-communicable diseases in UAE.

3.3 Potential Contributions and Limitations of the Study

There are many strength of this study as it is the first study to explore prevalence of physical activity in immigrant's living in UAE. Sample size quite large and considered a representative sample. Furthermore, this is the first study to show association between physical activity and selected sociodemographic and non-communicable disease risk factors in immigrant population living in the UAE and it support the finding of high prevalence of physical activity in the origin population.

The limitations of this study include: the cross-sectional study design which does not allow temporality and/or causality between physical activity and selected sociodemographic and non-communicable disease risk factors. Though, it is likely that physical inactivity lead to health problems. In addition, the study sample from the visa screening centre in the city of Al Ain, Abu Dhabi Emirate so, results generalization to other population might be questioned. However, its not expected that the socio-

economic and lifestyle characteristics of the study population to differ from migrants living in other Emirates of the UAE [4]. Furthermore, another important factor is the possibility of information or selection bias.

Subjective assessment of physical activity was utilized. Accurate measurement of PA may have numerous concerns [195]. Difficulty of validating a relationship between reported physical activity and biological measures might be a limitation of such method. Measurement of complex behaviours such as physical activity by questionnaire might be practical in epidemiological studies but, is limited because it generates a large measurement error. However, the IPAQ questionnaire was feasible choice for assessment of intensity, duration, frequency and type of activity. Furthermore, the self-reported physical activity questions have not been specifically validated in a South Asian population. Physical activity interpretation in south Asian may differ due to cultural or ethnic differences.

In this study compared with men, female expatriate exhibits more physical inactivity prevalence. This may be partly due to less access to exercising facilities and limited opportunities to engage in PA. There remains a need to further understand the personal, social and environmental barriers to PA in this population, mainly in relation to different domain of PA (leisure time, occupational, transports, and households PA). This aspect was not looked at in this study.

Finally, the occupational factors that might have impact on physical activity was not explored in depth. These occupational factors include: average working hours, psychological demands at work, shift work, type of transport and diet details as it affect physical activity related parameter like: BMI and central obesity.

Chapter 4: Conclusion

4.1 Conclusion

In conclusion, this study found that physical activity prevalence is low across UAE migrant population, specially, South Asians and female Arabs and those working as driver, in offices and as shop keepers with consequences for NCDs. Increasing physical activity in migrant population in UAE should be a public health priority.

4.2 Implications

The study findings have significant implications for health promotion efforts in UAE. First, these findings point to the importance of strengthening physical promotion in UAE. Implementing intervention and evaluation programs is important for reducing UAE high prevalence of obesity and non-communicable diseases. A large proportion of UAE population is migrants. One potential mechanism by which immigrant population may be less active is due to adoption of urbanized lifestyle in UAE. Physical activity promotion programs should target the vulnerable migrant's population especially South Asians and female Arabs and those working as driver, in offices and as shopkeepers. Prevalence of insufficient physical activity was lower in female Filipino compared to South Asian and Arab females, but compared to the global trend they have higher prevalence of insufficient physical activity than the reported in their home country probably due to acculturation. This should not exclude them from physical activity intervention. Furthermore, Migrants from rural home setting were less likely to be insufficiently active. Interventions should aim to maintain the higher physical activity levels associated with rural environments [168]. Also, type of

accommodation was significantly associated with insufficient physical activity and that should be taken in consideration when planning any health promotion program. Future studies should utilize a larger sample of UAE population to examine the level of PA, with an emphasis on various age cohorts. Further broader, extensive studies are recommended to be done including other emirates and designs in order to improve the application of future tailored and culturally sensitive health promotion campaigns, interventions, and policies amongst migrants.

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Appendix

International Physical Activity Questionnaire (IPAQ)

ID Number	_ _ _ _ _ _
Research Assistant Initials	_ _ _
Date of Interview	d d / m m / y y y y
Name of Participant	
Respondent's Name (if different from participant)	
Contact Number	

1. Respondent's Gender:	
Male	01 ☐
Female	02 ☐
2. Respondent's Nationality	
Philippines	01 ☐
Arab country _____	02 ☐
South East Asia _____	03 ☐
3. Setting of home in country of origin	
Rural	01 ☐
Urban	02 ☐
4. Date of birth (if unknown, age in years)	
5. What is your occupation?	
Housemaid	01 ☐
Babysitter	02 ☐

Cook	03 ☐
Driver	04 ☐
Housewife	05 ☐
Administrative	06 ☐
Teacher	07 ☐
Sales Assistant	08 ☐
Nurse	09 ☐
Doctor	10 ☐

6. How many years have you worked in this occupation in the UAE?

7. What is your monthly salary in local currency (AED)?

8. How many years have you lived in UAE?

9. Are you here with your immediate family?

Yes 01 ☐

No 02 ☐

10. Do you have a sibling in home country?

Yes 01 ☐

No 02 ☐

If yes:

	Gender	Location	Urban or Rural	
10.1 Sibling 1	M / F		U / R	
10.2 Sibling 2	M / F		U / R	
10.3 Sibling 3	M / F		U / R	
10.4 Sibling 4	M / F		U / R	

11. Type of Housing

Shared accommodation, with non relatives/hostel	01 ☐
Shared accommodation, with family	02 ☐
Single accommodation (live by yourself)	03 ☐

Living with Sponsor	04 ☐
Labor Camp	05 ☐
Other_____	06 ☐

SECTION A: General Information	
12. What is the highest class/level of education that completed?	
Illiterate	01 ☐
Primary (grade 1 to 5)	02 ☐
Middle (grade 6 to 8)	03 ☐
Secondary (grade 9 to 10)	04 ☐
High School Diploma graduate (grade 11 to 12)	05 ☐
College/University completed	06 ☐
Postgraduate degree	07 ☐
Don't know	99 ☐
13. What is your marital status?	
Never married	01 ☐
Married	02 ☐
Separated	03 ☐
Divorced	04 ☐
Widowed	05 ☐
Do not know	99 ☐
Refused	88 ☐
14. How many children do you have?	

15. What is your mother tongue?	
Tagalog	01 ☐
Arabic	02 ☐
Urdu	03 ☐
Hindi	04 ☐
Bangla	05 ☐
Malayalam	06 ☐
Other _____	07 ☐

16. a. Have you ever had your blood pressure measured before?	
Yes	01 ☐
No (skip to 17)	02 ☐
Don't know (skip to 17)	99 ☐
b. Has a health care provider ever told you that you have high blood pressure also called hypertension?	
Yes	01 ☐
No (skip to 17)	02 ☐
Don't know (skip to 17)	99 ☐
16.1 What was your age when you were told that you have high blood pressure?	_____ _ yrs
16.2 Because of your high blood pressure have you ever been told by a health care provider to take prescribed medicine?	
Yes	01 ☐
No	02 ☐
Don't know	99 ☐
16.3 Are you currently (since last month) taking any medicine for blood pressure?	
Yes	01 ☐
No	02 ☐
Don't know	99 ☐
16.4 Have you taken your blood pressure medicine today or during the last 2 days?	
Yes, today ……....	01 ☐
Yes, in the last 2 days ……....	02 ☐
	99 ☐

No ……	

Diabetes

17. Has a health care provider ever told you that you have diabetes?

Yes	01 ☐
No (skip to 18)	02 ☐
Don't know (skip to 18)	99 ☐

17.1 How was your diabetes diagnosed? *(More than one response possible)*

Had symptoms ……..	01 ☐
Screening test (high blood sugar) ……...	02 ☐
Sugar in urine ……...	03 ☐
Others (specify) _____	04 ☐

17.2 For how long have you had diabetes? _____ _ yrs

17.3 Were you prescribed any treatment or restricted diet for your diabetes?

Yes	01 ☐
No	02 ☐
Don't know	99 ☐

17.4 If yes, what type of current treatment are you taking for diabetes?

(More than one response possible)

Insulin injections …….	01 ☐
Tablets …….	02 ☐
Restricted diet …….	03 ☐
Others (specify) _____	04 ☐

17.5 Have you taken your diabetes medicine today or during the last 2 days?

Yes, today …….	
Yes, in the last 2 days …….	01 ☐
No, I did not take any medication …….	02 ☐
Why? _____	03 ☐
17. 6 Do you have a blood sugar checking device at home?	
Yes	
No	01 ☐
Don't know	02 ☐
	99 ☐

Other conditions

18. Have you ever been diagnosed with any of the following:	
18.1 **High Cholesterol**	
Yes	01 ☐
No	02 ☐
Don't know	99 ☐
18.1.a If yes, at what age were you diagnosed?	_____ yrs
18.1.b Have you ever had your blood lipids measured (cholesterol or triglycerides)?	
Yes ….	01 ☐
No ……	02 ☐
Don't know	99 ☐
18.2 **Kidney Disease**	
Yes	01 ☐

No	02 ☐
Don't know	99 ☐
18.2.a If yes, what kind of kidney disease did you have? _____	
	01 ☐
18.3 Are you taking any **medication** for the above conditions?	02 ☐
Yes _____.....	
No	
Family History	
19. Were any of your first-degree relatives (mother, father, brother, sister, son, daughter) told by a doctor or other health professional that they had:	
Hypertension ……	01 ☐
Heart Disease ……...	02 ☐
Cholesterol ……..	03 ☐
Kidney Disease ……	04 ☐
Diabetes ……	05 ☐
Stroke ……....	06 ☐
None ……... .	07 ☐
Other (specify) _____.....	08 ☐
Medicine History	
20. Do you take any of the following medicines?	
Aspirin	01 ☐

Statin	02 ☐
Ace-inhibitor	03 ☐
Thiazide diuretic	04 ☐
Beta-Blocker	05 ☐
AII Blocker	06 ☐
CCB	07 ☐
Metformin	08 ☐
Insulin	09 ☐
Other oral antihypoglycemic	10 ☐
None	11 ☐
……..	12 ☐
Other (specify)_____	
Physical Activity (International Physical Activity Questionnaire)	
Vigorous	
Think about all the **vigorous** activities that you did in the **last 7 days**. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal.	
21. During the **last 7 days**, on how many days did you do **vigorous** physical activities? (Give examples applicable to occupation)	
1 Day	01 ☐
2 Days	02 ☐
3 Days	03 ☐
4 Days	04 ☐
5 Days	05 ☐
6 Days	06 ☐
7 Days	07 ☐
None (skip to 23)	08 ☐
Don't know (skip to 23)	99 ☐
22. How much time did you usually spend doing **vigorous** physical activities on one of those days?	__hrs___min

Moderate	
Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.	
23. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.	
1 Day	01 ☐
2 Days	02 ☐
3 Days	03 ☐
4 Days	04 ☐
5 Days	05 ☐
6 Days	06 ☐
7 Days	07 ☐
None (skip to 25)	08 ☐
Don't know (skip to 25)	99 ☐
24. How much time did you usually spend doing **moderate** physical activities on one of those days?	__hrs___min
Walking/Sitting	
Think about the time you spent walking in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.	

20. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time? 1 Day 2 Days 3 Days 4 Days 5 Days 6 Days 7 Days None (skip to 27) Don't know (skip to 27)	01 ☐ 02 ☐ 03 ☐ 04 ☐ 05 ☐ 06 ☐ 07 ☐ 08 ☐ 99 ☐
21. How much time did you usually spend **walking** on one of those days?	__hrs__min
22. During the **last 7 days,** how much time did you spend sitting on week days during the **last 7 days**? Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.	__hrs__min
Tobacco Use (WHO STEPS)	
23. Do you **currently** smoke any tobacco products, such as cigarettes and hookah? Yes No (skip to 33)	01 ☐ 02 ☐
24. Do you **currently** smoke tobacco products daily? Yes No	01 ☐ 02 ☐
25. How soon after you wake up do you smoke? Within 5 minutes 6-30 minutes 31-60 minutes More than 60 minutes	01 ☐ 02 ☐ 03 ☐ 04 ☐
26. How old were you when you first started smoking daily?	

Age (years)_____	01 ☐
Don't know	99 ☐
27. On average, how many of the following do you smoke each day?	
28.1 Manufactured cigarettes _____	
28.2 Hookah _____	
28.3 Other (specify)_____	
28. In the **past**, did you ever smoke daily?	
Yes	01 ☐
No (skip 36)	02 ☐
29. How old were you when you first started smoking daily?	
Age (years)_____	01 ☐
Don't know	99 ☐
30. How old were you when you stopped smoking daily?	
Age (years)_____	01 ☐
Don't know	99 ☐
31. Do you **currently** use any smokeless tobacco such as *(paan masala, khat, shamma, masheri, zarda, gutka, mawa)*?	
Yes	01 ☐
No (skip to 38)	02 ☐
32. On average, how many times a day do you use:	
33.1 Paan Masala_____	
33.2 Khat _____	
33.3 Shamma _____	
33.4 Masheri_____	
33.5 Zarda _____	
33.6 Gutka _____	
33.7 Mawa _____	

33. In the **past**, did you ever use smokeless tobacco?	
Yes	01 ☐
No	02 ☐
34. During the past 7 days, on how many days did someone in your home smoke when you were present?	
35. During the past 7 days, on how many days did someone smoke in closed areas in your workplace (in the building, in a work area or a specific office) when you were present?	
Alcohol Consumption (WHO STEPS)	
36. Have you ever consumed an alcoholic drink such as beer, wine, spirits?	
Yes	01 ☐
No (skip to 46)	02 ☐
37. Have you consumed an alcoholic drink in the last 12 months?	
Yes	01 ☐
No (skip to 44)	02 ☐
38. During the past 12 months, how frequently have you had at least one alcoholic drink?	
Daily	01 ☐
5-6 days per week	02 ☐
1-4 days per week	03 ☐
1-3 days per month	04 ☐
Less than once a month	05 ☐
39. Have you consumed an alcoholic drink within the past 30 days?	
Yes	01 ☐
No (skip to 46)	02 ☐
40. During the past 30 days, when you drank alcohol, on average, how many standard alcoholic drinks did you have during one drinking session?	
Diet (WHO STEPS)	
41. Do you add extra salt on your food?	
Yes	01 ☐
No (skip to 48)	02 ☐

42. How often do you add salt on your food?	
Occasionally (<7/week)	01 ☐
Often (>7/week)	02 ☐
Always	03 ☐
43. In a typical week, on how many days do you **eat fruit**?	
Number of days	
44. In a typical week, on how many days do you **eat vegetables**?	
Number of days (if 0, skip to 52)	
45. How many **times** do you eat vegetables on **one** of those days?	
Number of servings	
46. Are you a lifelong vegetarian?	
Yes (skip to 55)	01 ☐
No	02 ☐
47. In a typical week, on how many days do you **eat red meat**?	
Number of days	
48. In a typical week, on how many days do you **eat white meat**?	
Number of days	
49. In a typical week, on how many days do you **eat fish?**	
Number of days	
Please recall the food you consumed in the last 24 hrs or previous day	

Breakfast	_____ _____
Lunch	_____ _____ _____ _____
Dinner	_____
Snacks	
Tea/Coffee	

SECTION C: Physical Examination			
Next I will conduct a short physical examination			
50. Have you smoked a cigarette or taken coffee or tea in the last 30 minutes? Yes No			01 ☐ 02 ☐
Blood Pressure			
	Systolic	Diastolic	Pulse
51. Reading 1			
52. Reading 2			
53. Reading 3			
Physical Measurements			
54. Height		55. Hip circumference	
56. Weight		57. Waist circumference	