Life Style Factors and their Relationship with Cardiovascular diseases

By

Naheeda Parveen

NUST201362737MSEECS60013F

Supervisor

Dr. Sharifullah Khan

Department of Computing

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Approval

It is certified that the contents and form of the thesis entitled "**Life Style Factors and their Relationship with Cardiovascular diseases**" submitted by **Ms**. **Naheeda Parveen** has been found satisfactory for the requirement of the degree.

Advisor: **Dr. Sharifullah Khan**

Signature: _____

Date: _____

Committee Member 1: **Dr. Muhammad Muneeb Ullah**

Signature: _____

Date: _____

Committee Member 2: **Mr. Fahad Ahmed Satti**

Signature: _____

Date: _____

Committee Member 3: **Dr. Muhammad Azeem Abbas**

Signature: _____

Date: _____

Dedication

With affection and gratitude, I would like to dedicate this thesis to my parents and teachers who have been remain a continuous source of inspiration and motivation for me and support me all the way.

Certificate of Originality

I hereby declare that this submission is my own work and to the best of my knowledge it contains no materials previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any degree or diploma at NUST SEECS or at any other educational institute, except where due acknowledgement has been made in the thesis. Any contribution made to the research by others, with whom I have worked at NUST SEECS or elsewhere, is explicitly acknowledged in the thesis.

I also declare that the intellectual content of this thesis is the product of my own work, except for the assistance from others in the project's design and conception or in style, presentation and linguistics which has been acknowledged.

Author Name: **Naheeda Parveen**

Signature: _____

Acknowledgment

In the name of Allah the beneficent and merciful, on whom we all are dependent for eventual support and guidance.

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Abstract

Cardiovascular diseases (CVD) such as hypertension and ischemic heart diseases cause 35 to 40% of deaths every year in Pakistan. Several life style factors such as smoking, dietary habits, lack of exercise, mental stress, body habitus (i.e., BMI and waist), personal habits (i.e., dietary habits, sleep and smoking) and clinical conditions (i.e., diabetes, dyslipidemia and hypertension) have been shown to be strongly associated with the etiology of CVD. Epidemiological studies in Pakistan have shown poor adherence of people to healthy life style and lack of knowledge of adopting alternatively healthy habits. There are well validated cardiovascular risk estimation tools that can predict the probability of future cardiac events. The existing tools are based on laboratory investigation of biochemical tests. There is no widely acceptable tool available that predicts the CVD risk based on life style factors. This research aims to develop alternative CVD risk estimation model based on life style factors and physical attributes without conducting any clinical test by using QRISK model as the gold standard. In this research, 160 subjects participated in the case cross over design study to find out the risk probability based on BMI (body mass index), waist circumference, physical activities (i.e., stamina, strength, flexibility and posture), smoking, general illnesses, dietary intake, stress and physical characteristics as predictors and thereby indirectly predicting the future cardiovascular disease events risk. Principal component analysis (PCA), bivariate correlations and Regression analysis were used to assess the relationship among predictor variables and cardiovascular risk score. Four predictors, i.e., Chronological age, waist circumference, BMI (body mass index) and strength showed significant effect on cardiovascular disease risk probability. Multiple-linear regression was applied on features extracted through PCA to create a prediction model/equation of QRISK Cardiovascular Probability. CVD risk can be measured up-to 72.9% accuracy with the new model created in this research. Very few heart patients were part of this study. Mostly people were healthy or at medium risk of cardiovascular diseases. All participants were male, so a large scale study can be conducted by including male and female to further prove the results.

Chapter 1

Introduction

This chapter describes the basic concepts involved in this research. It also presents the problem and motivation towards conducting this study. Moreover it also provides insight towards the proposed solution and procedure to get and evaluate the results. Finally the end of this chapter presents the structure of this document.

1.1 Motivation

Numerous studies have shown association between life style factors and cardiovascular diseases. Currently obesity due to sedentary life style has become one of major concerns in developing countries. Life style has many impacts on an individuals health. Unhygienic food and not doing any physical activity during the day leaves very negative impacts on health which results different diseases like metabolic problems, stomach issues, diabetes, chronic and heart diseases [21]. Dietary intakes have association with chronic illnesses and it has been documented in many studies [16][11][23][41]. Availability of fast foods is considered to be linked with sedentary, increases consumption of fats which are ultimately associated with chronic conditions [31]. Therefore, analysis of diet as a risk factor is a key for chronic diseases such as diabetes, hypertension and heart diseases [25]. These days, primary prevention of chronic diseases emphasize on modification of life style and diet pattern as diet related disorders are increasing chronic diseases such as cardiovascular, diabetes and hypertension [43][42][17].

Physically inactive is fourth leading cause of death in the world and a well-known reason for the development of cardiovascular diseases [28]. In general, there are many evidences that exercise contributes a lot to better health and quality of life. Taking breaks during busy day and performing

some physical activities leave positive effects on health [30]. According to Disease Control and Prevention (CDC) [2], risk of many chronic diseases can be reduced with regularly performing physical activities which keeps a person fit. In 2008, CDC published set a of physical activity recommendations for the people aged six and older. This set contained total amount of physical activity to achieve a range of health benefits.

In 2010, WHO also published globally recommended set of physical activities [36]. There exists some other lesser known literature as well to motivate people about life style and performing physical activities. All these guidelines emphasize on importance of physical activity for healthy life style and well-being of people. In developing countries like Pakistan, in spite of public availability of all these guidelines either people are not aware about them or unable to understand and follow them. In result mostly people in Pakistan do not follow hygienic diet plan and also do not perform exercise regularly which increases disease rate especially diabetes and cardiovascular diseases. Stress and use of alcohol are also modifiable risk factors for cardiovascular diseases [10]. Stress contributes to high blood pressure which is ultimately a risk factor for CVD [12].

The current study was planned to identify different risk factors of cardiovascular diseases either modifiable or not modifiable, to score them by using a scoring system and then find/explore the association of these risk factors with cardiovascular risk score/probability calculated by QRISK Intervention. This will help us to bring awareness among people to adopt healthy life style and take preventive actions before going for costly clinical tests.

1.2 Statement of the Problem

Cardiovascular diseases (CVD) will be the responsible for 32.5% of all deaths by 2030. According to the estimate for the year 2020, the largest increase in number of deaths from cardiovascular disease will occur in Southeast Asia [34]. As much as the human body is complex, so are the issues of human health. People pay less attention towards life style due to which obesity, high blood pressure, unhygienic food, physical inactivity is increasing which in turn result in developing different chronic diseases such as hypertension and cardiovascular diseases. Around 3.4 million adults die each year as a result of being overweight or obese. This situation is due to increased consumption of fats, sedentary life style and lack of exercise/physical activities. Furthermore, people do not have enough awareness about the health problems and importance of exercise in daily life. The medical experts and doctors focus more on treating the diseases with medication rather than by

emphasizing on life style modifications. This research aims to develop a model on the basis of cardiovascular risk factors, based on life style based. The model will create awareness among people about life style factors for preventive actions.

1.3 Statement of the Purpose

The purpose of the study was to identify the cardiovascular disease risk factors based on life style and to conduct a cross sectional examination of the relationship between identified risk factors, chronological age and cardiovascular risk probability. First, QRISK Intervention was used to calculate the cardiovascular risk score of studied population then relationship was assessed between identified risk factors and cardiovascular risk score. Results of this research provided useful information to take preventive actions for cardiovascular diseases.It was also helpful to create awareness among studied population about modifiable life style factors for their future guidance.

1.4 Contribution

This study identifies the cardiovascular risk factors related to life style to assess initial CVD risk. It is the most cost effective approach to measure fitness level. Usually a person has to spend high cost on preliminary lab tests to diagnose heart diseases but through this research one would be able to identify his initial risk of CVD based on his life style factors and different nonclinical variables. If he finds some alarming risk then he may go for detail tests instead of spending high cost without any indication. In sedentary life style people pay less attention to life style and physical activities but in this research major focus is on healthy life style and preventive actions of heart diseases.

1.5 Definition of terms

The following terms are defined and used throughout this research.

- **Chronological age:** Number of years, months and days passed since the birth of the person. It is calendar based [3].

- **Cardiovascular diseases:** Cardiovascular diseases includes all problems related to circulatory system, hypertension, coronary heart dis-

eases, rheumatic heart disease, pulmonary embolism and heart failure [19][33].

- **Cardiovascular risk score/probability/assessment:** Cardiovascular risk score is a 10-year probability of developing cardiovascular diseases for an individual [22].

- **Cardiovascular risk factors:** Trends/ Traits that raise the risk of heart diseases.

1.6 Thesis Structure

Rest of the thesis document is structured as, Chapter 2 describes the background of the the study. Next Chapter 3 is about related work. It explains literature of existing applications and their weaknesses. Detail about methodology of the research has been described in Chapter 4. Evaluation of the results and discussion on results is mentioned in Chapter 5. Chapter 6 concludes entire thesis. Limitation and future of this research are also discussed in Chapter 6.

Chapter 2

Literature Review

This chapter describes the background of the study. Existing cardiovascular disease risk estimation methods were also studied. Last section examines the importance of cardiovascular risk factors which can be measured without major clinical tests and existing studies.

2.1 Cardiovascular disease

In Pakistan, almost 200,000 people die every year due to heart diseases which is 35% to 40% of total death rate in Pakistan [5]. In Pakistan it is estimated that one in four adults suffer from cardiovascular disease. Risk factors include high blood pressure (HBP), smoking, increased cholesterol, and being Overweight [26]. There are multiple other causes of this condition such as hypertension, diabetes, smoking, dyslipidemia, unhealthy diet, lack of exercise, psychiatric conditions in particular anxiety and depression. Lack of awareness about importance of a healthy lifestyle is one the major cause of developing cardiovascular diseases [5].

Heart diseases terminology refers to the terms coronary heart disease, cardiovascular disease, atherosclerotic cardiovascular disease (ASCVD) and coronary artery disease (CAD).Coronary heart disease which is also called coronary artery disease is a condition in which small blood vessels either gets narrowed or blocked that supply blood and oxygen to heart of a person [35]. Cardiovascular diseases include all problems related to circulatory system, hypertension, coronary heart diseases, rheumatic heart disease, pulmonary embolism and heart failure [19][33]. Atherosclerotic cardiovascular disease (ASCVD) includes coronary heart disease (CHD), peripheral arterial disease, and stroke, all of presumed atherosclerotic origin [39].

2.2 Cardiovascular Risk Scores

Cardiovascular risk score remains a foundation to assess/predict cardiovascular event over a period of time (usually 10 years). Multiple equations/algorithms of cardiovascular risk score have been proposed to calculate the risk factor. The Framingham Heart Study is still considered an outstanding research since its start in 1948 and continues to date with new versions. It was a remarkable advancement in the risk assessment, understanding the complexities of cardiovascular disease (CVD) causes and the primary prevention of cardiovascular morbidity and mortality [29]. Initially, Framingham risk equation was used to assess the risk of coronary heart diseases and then it was modified to assess the 10 years risk by using constituent risk factors (i.e., age, blood pressure, total cholesterol or low density lipoprotein (LDL) level,high density lipoprotein (HDL) level, smoking status, and the presence of diabetes mellitus) [14]. Research focus was evolved from coronary heart diseases assessment to cardiovascular disease prediction in 2008 and cardiovascular risk assessment of 10 years was published [15].

The Framingham Risk Score (FRS) [8][44] has limited accuracy of overestimating the risk in low risk populations and under-estimating in high risk populations. Secondly Framingham study targeted only white male cohorts and it did not consider ethnicity [13]. To address the gender difference in cardiovascular risk prediction, Reynolds risk score was proposed by Ridker, Buring, Rifal and Cook (2007) for women. Reynolds risk score equation was based on same factors of Framingham in addition to family history of cardiovascular disease and life style factors [32]. Pooled Cohort Risk Equation is the clinical risk assessment score recommended in the 2013 American College of Cardiology (ACC)/ American Heart Association (AHA) Guidelines on the Assessment of Cardiovascular Risk [19]. It was developed to update guidelines on cholesterol, blood pressure, and overweight/obesity with the optimal clinical cardiac risk assessment model[19]. Minority was also included in this study to address the ethnicity diverse populations and people of both genders male and female were part of the research [19]. QRISK (Q Research Cardiovascular Risk Algorithm) Intervention [6] has been developed by the University of Nottingham (UK) to predict the 10-years probability of developing diabetes and cardiovascular diseases in an individual. It computes the risk of the diseases on the basis of clinical variables such as blood pressure, total cholesterol/HDL ratio, body mass index (BMI), family history of diabetes and cardiovascular disorders, presence of atrial fibrillation and rheumatoid arthritis [22]. It is well validated algorithm [22]. Cardiovascular risk score of QRISK intervention was used in the current study.

2.3   Life Style Factors

Obesity and overweight are classified by the body mass index and in case it is between 25 to 29.9 then an adult will be considered overweight and if BMI value is above 30 then it will considered obesity. Fatness is associated with heart events like heart failure and cardiac diseases [37].

To assess fitness of a person, intensity of doing different physical activities are really important. A physical activity is considered as any act performed by the user that involves significant movement of the various parts of the body. According to the WHO physical activity recommendations [36], one needs to do two types of physical activity each week to improve your health aerobic and muscle strengthening. Furthermore, such activities can be of moderate or vigorous intensity. An aerobic activity is that which gets ones heart beat faster and breathe harder than when one is not performing it. It includes activities from walking, running, pushing a lawn mower, to taking a dance class, to biking to the store etc. Muscle-strengthening activities are those which work all the major muscle groups of the body (i.e., legs, hips, back, chest, abdomen, shoulders, and arms). For better health outcomes, one has to carry out both aerobic and muscle strengthening activities. For this research we are considering four physical activities stamina, strength, flexibility and posture test. Each physical activity is defined by its duration and intensity. Duration is the amount of time spent participating in a physical activity session. Intensity is the rate of energy expenditure and can be considered as light, Moderate, or vigorous. For an activity to be considered as useful for health, it should be performed at a moderate or vigorous intensity for at least 10 minutes at a time [36]. Other factors dietary intake, usage of smoking/drugs, different psychosocial feelings also affect a persons health w.r.t cardiovascular diseases.

2.4   Cardiovascular Risk Factors

2.4.1   Obesity /Overweight/fatness

Obesity and overweight is modifiable metabolic disorder and is associated with increased blood pressure and blood sugar. These are associated with many cardiac conditions like hypertension, heart failure, and cardiovascular diseases [24][37]. It has been shown that weight gain in adults has increased the risk of CVD [24]. Body mass index is usually measured to check obesity and overweight. Normally BMI above $30kg/m^2$ is categorized as obese and being $25kg/m^2$ to $30kg/m^2$ as overweight. Addition of waist circumference

to BMI is good predictor of obesity instead of using just BMI measure [27]. There are multiple reasons of being overweight/ obese e.g. sedentary life style, lack of physical activities,diet routine [21].

2.4.2   Lack of Physical Activities

Physical activity is movement of muscles beyond the rest condition for the expenditure of energy [40].It includes swimming, running, press ups, periodic step up/down etc to strengthen the muscles [40]. One of the well-known risk factor of developing cardiovascular diseases is lack of performing regular exercise/physical activities [28]. It is stated that coronary heart diseases risk can be reduced by performing exercises regularly, means it can be taken as preventive action [40].

2.4.3   Smoking/Alcohol/Drugs

Smoking is well known for making destructive effects on the human body, particularly on the cardiovascular system. Also, smoking is termed as the most significant preventable risk factor for cardiovascular disease [9]. Usage of tobacco is associated with risk of cardiovascular diseases [26]. Stopping smoking/tobacco significantly reduces the risk of developing cardiovascular diseases and coronary heart diseases.

2.4.4   Illnesses and Complaints

Family history of the person is an important risk factor, if the close relatives or family member has been ever suffered from cardiovascular diseases [7]. It may be used to advise young patients for preventive actions if they have cardiovascular disease history in family. Family history has been used in many risk assessment algorithms, e.g., QRISK Intervention [6]. Presence of diabetes also increases the risk of cardiovascular diseases and coronary heart diseases irrespective of presence of other risk factors. Diabetes also caused the hypertension and obesity which are ultimately significant risk factors for CVD [18]. Other general seasonal diseases (i.e., flu, eye infection, mouth ulcer, constipation) also effect on human body.

2.4.5   Dietary Intake

Different researchers have found that dietary intakes are associated with chronic illnesses such as hypertension and CVD [16][11][23][41]. Usage of fruits and vegetables in daily routine reduces the risk of stroke, cardiovascular

diseases and hypertension. Polyunsaturated fats (i.e., wholegrain cereals and fish) are also protective while saturated fats (i.e., full cream milk, cheese, beef, and full dairy products) are associated with increased risk of cardiovascular diseases [38]. Dietary potassium reduces the risk of stroke and hypertension, sources of dietary potassium is pulses and white beans [38].

2.4.6 Mind and Life Style (Daily Routine)

Routine tasks, e.g., either a person does morning walk, sleep adequate hours without tiredness, spend some time on entertainment, married or single are important factors while assessing risk factors of cardiovascular diseases [7].

2.4.7 Stress

Adverse circumstances result in emotional/mental state in mostly people and it is part of life. Stress causes increase in blood pressure which may be associated with cardiovascular diseases [12]. Stress was strongly associated with cardiovascular disease patients in study [7] which was conducted in Swat, Pakistan to assess the risk factors of CVD for people of Swat.

2.4.8 Outer You

Appearance of person in relation to diseases prediction was studied in [20]. Women with lower risk of cardiovascular diseases were looking younger in appearance as compared to their chronological age while high risk women were older in looks [20].

2.5 Critical Analysis/Gaps

One of the major gap in above studies is that each one is focusing on specific CVD risk factors. People pay less attention to life style. In sedentary life style, it is important to evaluate risk factors which can be reduced through life style modifications. To date, no significant study was conducted in Pakistani population to evaluate risk factors which was based on different ethnic people. One study was conducted [7] for a particular region but that also did not use any authenticated tool to verify cardiac disease risk. Currently, in Pakistan, only rudimentary practice of preventive cardiology exists in the public and private health sector. The high incidence of cardiovascular diseases can be addressed through primary preventive strategies and

creating awareness among general public besides their actual management and secondary prevention. This strategy would not only significantly reduce mortality and morbidity but also the socioeconomic costs.

Chapter 3

Methodology

This chapter provides the proposed methodology of this research. The study design is also part of this chapter. Later, it describes measurement of all features in detail and also mentions life style application that was developed as a part this research.

3.1 Specific Aims

Specific aims of this research were :

- First aim was to identify all those life style factors through literature which could be potential risk factors for cardiovascular diseases. All these are modifiable and a person can improve them by adopting healthy alternatives for that particular factor. For example, usage of saltish food can be reduced in daily routine to minimize the risk of disease. All identified risk factors have been grouped together according to their properties as given in Figure 3.1.

- Second aim was to calculate cardiovascular risk probability of each participant by using QRISK Intervention [6]. All required attributes of QRISK were also recorded for each participant in addition to cardiovascular probability.

- After collecting data of life style factors and QRISK intervention, data was analyzed by applying selected techniques i.e., Principle component analysis (PCA) , correlation and regression. QRSIK probability was used as dependent variable while all life style factors identified in first step were used as predictors/independent variable of probability.
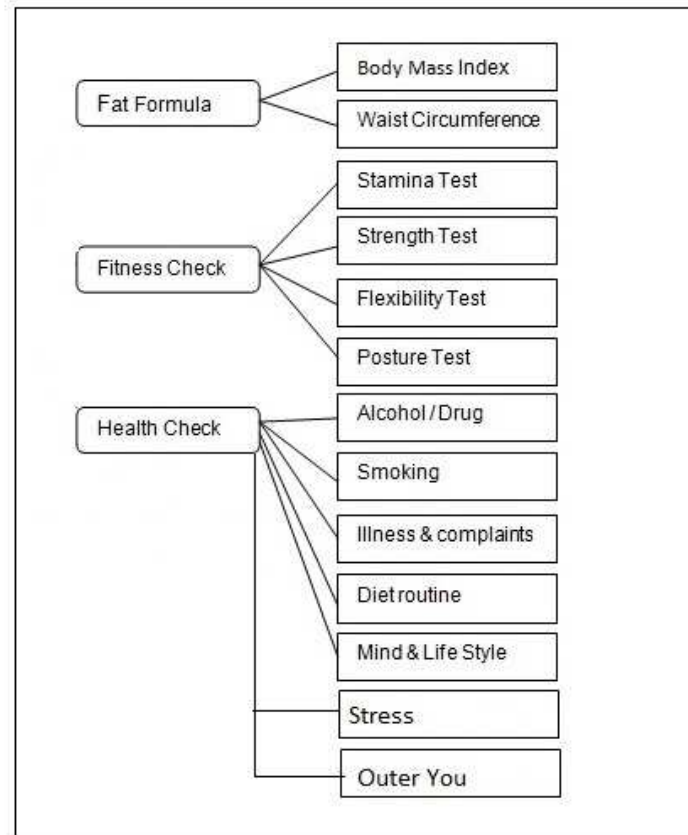
Figure 3.1: Risk Factors Grouping

3.2   Proposed Methodology

Overall methodology of the study is shown in Figure 3.2

- In data collection phase, sample population was selected i.e., people of NUST(age>25). Data was recorded for each life style factor. A complete data file contained both data of life style factors and cardiovascular risk probability. Normalization was applied on all features including outcome variable i.e., cardiovascular risk probability.

- Data was analyzed by applying different techniques on normalized data. First Principal component analysis was applied to extract important features of data. Correlation was also checked and in the end multiple linear regression was applied on extracted features. Cardiovascular risk probability was used as outcome variable.

- In the end, findings of the statistical analysis were compiled. Concluded

Figure 3.2: Methodology

results and findings were also discussed.

3.3   Research Questions and Hypotheses

Research questions and hypotheses of this study are made based on purpose and specific aim of the research.

Research Question 1.0: Which are modifiable life style factors which could be strongly correlated with cardiovascular diseases?

RQ1 Hypothesis 0: Life style factors have no significant effect on cardiovascular diseases.
The Alternative Hypothesis was defined as follows:
RQ1 Hypothesis 1: Life style factors have significant effect on cardiovascular diseases.

Research Question 2.0: How can modifiable life style factors be used to predict cardiovascular risk probability?

RQ2 Hypothesis 0: Life style factors have significant effect on cardiovascular diseases but can not be used solely as initial predictors of cardiovascular risk probability.
The Alternative Hypothesis was defined as follows:
RQ2 Hypothesis 1: Life style factors have significant effect on cardiovascular diseases and can be used solely as initial predictors of cardiovascular risk probability.

3.4 Study Design

A case cross over study design was chosen to prove the hypotheses. Medical camp was hold for two days in NUST to collect data. Medical campaign was run in NUST to motivate people to become a part of Medical camp before the schedule day. A questionnaire was prepared which contained all cardiovascular risk factors as mentioned in Figure 3.1. Another questionnaire was prepared which contained all attributes of QRISK Intervention. Staff of Pharmaceutical Company Pharmevo [4] took all medical/blood tests which were later on used to calculate cardiovascular risk probability through QRISK Intervention.Staff of NUST Medical Center was responsible for monitory physical activities to fill the questionnaire.

3.5 Scoring System

In this research scoring system was used to assign values to CVD risk factors. Positive values are assigned to values which affects negatively in person's health and negative scores have been assigned which leave positive affect on person's health w.r.t cardiovascular diseases.
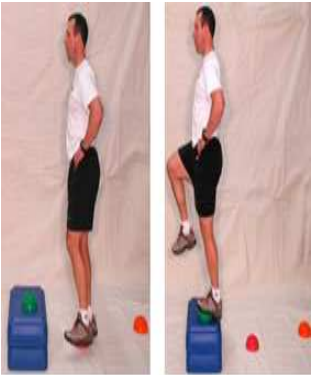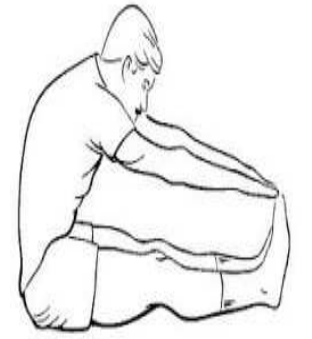
3.6 Measurement of Fat Formula

BMI was calculated from weight (kg) and height (m) by using following equation. Waist Circumference is calculated in inches. Waist was measured by using waist measurement tape. Participants were asked to stand straight and breath out slowly.

$$BMI = Weight(kg)/Height(m)^2 \tag{3.1}$$

3.7 Measurement of Fitness Check

Detail of the activities is shown in Table 3.1. Based on these rules we placed user into activeness level depending on his/her achieved progress.

Table 3.1: Detail of Physical Activities

Activity Name	Detail	Pictorial Description
Stamina	It represents cardiovascular system and lungs fitness. To carry out this test, a stair, about 12 inches high is used in a convenient place. Participants are asked to step up and down on it for three minutes exactly (step up with right foot, up with left, down with right, down with left and so on). Immediately the 3 minutes are up, exertion state is recorded as per values of stamina given in Table 4.1	
Strength	It represents the amount of force, a person can exert to push, pull and lift. Muscle strength declines with age if not maintained with weight bearing exercises. The press up test is used to assess body strength. Participants were asked to do it and continue until they cant do any more (muscles begin to shake) and then record value of press ups as as per values of strength given in Table 4.1	
Flexibility	The Sit and Reach Test is used to assess flexibility. Participants are asked to Warm up first. Take a walk or exercise a bit before this test then sit on a rug/carpet /mat on the floor with your legs straight out in front of you. Just slightly apart. Feet should be flexed (toes pointing to the ceiling). Arms at your side. Lower back straight. Shoulder relaxed. Stretch out your fingers towards the toes. Flexibility is recorded as per values of flexibility given in Table 4.1	
Posture	Poor posture (the way a person stands, sits or even walks or runs) is a real give-away of age and can add years on to any man. Participants are asked to stand with back of head, shoulders, tail bone and heels all touching the wall at the same time to assess if they can stand or not?	

3.8 Measurement of Health Check

3.8.1 Alcohol/Drugs

Multiple researches have proved that increased intake of alcohol causes obesity in a person and ultimately increases risk of high blood pressure. It was measured on the basis of an individuals consumption and marked from possible values of excessive, moderate, small, ex-drinker and None. All participants were muslims and reported as not using alcohol or drugs.

3.8.2 Smoking

Cigarette smoking plays an important role in developing cardiovascular diseases in any individual. It was measured on the basis of consumption of cigarette per day.

3.8.3 Illness and Complaints

A physician usually asks about medical history of patient/family to diagnose his present disease and prepares case history. Intensity of general illnesses like flu, eye infection, colds etc. are measured to assess the health. A List of general illnesses is compiled and scoring system is used to score every illness based on its intensity/frequency.

Table 3.2: List of Illnesses with Score

Condition	Often	Sometimes	Rare/Never
Colds	+2	+1	0
Flu	+2	+1	0
Gskin/Eye Infections	+2	+1	0
Cold Sores(lips/nose)	+2	+1	0
Mouth Ulcers	+2	+1	0
Bleeding gums	+2	+1	0
Constipation	+2	+1	0
Heartburn	+2	+1	0
Backache	+2	+1	0
General aches/pains	+2	+1	0

In addition to above general illnesses if any major disease is already diagnosed in that individual then that information will also be used to calculate health check score. If he/she is suffering from diagnosed conditions of blood

pressure, diabetes, heart attack, cardiac surgery then score of 2 will be added for each condition. Score of 1 will be added for each in case person has family history of chronic conditions of these major diseases, angina or coronary disease but no heart attack. All above scores will be added to calculate final illness score according to Table 3.3

Table 3.3: Illness and Complaints Score

Added value of all diseases	Illness and complaints score
+15 or more	+2
+8 to +14	+1
0 to +7	+0

3.8.4 Diet

It is already studied and proved in multiples researches that dietary intake impacts heart related diseases, e.g., sodium intake shows relationship with hypertension which is ultimately link with cardiovascular diseases. A List of food items is compiled which are important for health. Points are allocated on the basis of any persons daily usage frequency using Table 3.4

Table 3.4: Food items with Score

Item	Often	Sometimes	Rare/Never
Fruit	-1	0	+1
Vegetables	-1	0	+1
Fish	-1	0	+1
Wholegrain cereals	-1	0	+1
Pulses	-1	0	+1
Full Cream Milk	+1	0	-1
Full fat dairy products	+2	0	-1
Red Meat	+1	0	-1
Puddings/Cakes	+2	0	-1
Chocolates/sweats	+2	0	-1
Sugary drinks	+2	+1	0

Score of all items will be added to find the final score of diet according to Table 3.5

Table 3.5: Diet Score

Added value of all diet items	Diet score
+6 to +10	+2
+2 to +5	+1
+1 to +2	0
-5 to 0	0
-10 to -6	-2

3.8.5   Mind and Life Style

Routine actions are scored according to Table 3.6 & Table 3.7. Some of the chosen questions are simply Yes/No and some are based on frequency of action, i.e., those actions are performed often, sometime or rarely.

Table 3.6: Mind and Life Style Questions-1

Question	Yes	No
Do you take a walk (or similar) in the fresh air every day?	-1	+1
Do you take time every day to relax and do something enjoyable?	-1	+1
Do you frequently work long hours? (More than 8 hours daily)?	+1	-1
Do you regularly have to drive long distances/ in rush hours?	+1	-1
Do you have sex regularly(for married only)	-2	+2

Table 3.7: Mind and Life Style Questions-2

Question	Often	Sometimes	Rarely
Without sleeping pills, do you wake in the morning feeling refreshed?	-1	0	+1
Would you say you have good energy levels?	-1	0	+1
Do you feel tired after adequate hours of sleep?	+1	0	-1

In addition to above questions, memory related question are added to check memory ability of a person. Above all values are added and the final score of mind and life style is evaluated according to Table 3.8

Table 3.8: Mind and Life Style Score

Added up score	Final Score
+6 to +11	+4
+1 to +5	+2
0	0
-1 to -5	-2
-6 to -11	-4

3.8.6 Stress

Stress is the measure of different psychosocial factors. Different researches have proved that stress has relationship with cardiovascular diseases. Different kind of psychosocial factors are compiled and scored according to Table 3.9.

Table 3.9: Stress Conditions

Condition	Often	Sometimes	Rarely/Never
Upset at little things	+1	0	-1
Angry or resentful	+1	0	-1
Isolated or lonely	+1	0	-1
Inadequate or useless	+1	0	-1
Anxious, nervous	+1	0	-1
Depressed	+1	0	-1

All values are added according to frequency of these psychosocial factors and the final score of stress is made according to Table 3.10.

Table 3.10: Stress Score

Added up score	Final Score
+4 to +6	+2
+1 to +3	+1
0	0
-1 to -3	-1
-4 to -6	-2

3.8.7 Outer you

Score 1 will be added for each Yes answer of following questions and the final score of outer will be calculated according to Table 3.11.

- Are your teeth all your own?

- Are your teeth in good condition?

- Are the whites of your eyes bright and clear?

- Is your skin healthy colour?

- Is your skin smooth and pleasant in appearance?

- Is your hair plentiful?

- Is your hair shiny and healthy?

- Do people ever take you for younger than you really are?

- Do you shave? (no facial hair)

- Do you color your hair?

Table 3.11: Outer you Score

Added up score	Final Score
+5 to +8	-2
+2 to +4	-1
Under 2	0

3.9   Measurement of Outcome Variable

Qrisk Intervention [6] is an online available tool to calculate risk of diabetes and cardiovascular diseases in the next 10 years of a person. Its interface is shown in Figure 3.3

Figure 3.3: QRISK Intervention Interface

A user has to give answers of following questions in QRISK intervention to calculate risk of diabetes and cardiovascular diseases

- Do you smoke at all?

- Do you have diabetes?

- Are you on regular steroid tablets?

- Do you have high blood pressure requiring treatment?

- Have you had a heart attack, angina, stroke or TIA (a mini-stroke with full recovery within 24hrs)?

- Has anyone in your immediate family* had angina or a heart attack whilst under 60?

- Do immediate family* have diabetes?

- Have you been diagnosed with rheumatoid arthritis?

- Have you been diagnosed with chronic kidney disease?

- Have you been diagnosed with atrial fibrillation or irregular heartbeat?

- Do you have congestive cardiac failure?

- Do you have hypothyroidism?

- Do you have liver failure?

- Cholesterol/HDL ratio

- Systolic blood pressure (mmHg)

- To calculate Body Mass Index input Weight(kg) and Height (cm)

3.10   Life Style Application

Life Style is a web based application, developed using JAVA that incorporates all necessary components of life style to assess the health of a person. It tends to promote the physical activities and lifestyle improvement instead of medical checkups to assess the health. It requires the user to input all correct information about his routine, perform physical activities according to displayed instructions and enters his psychosocial feelings. Scores/points are awarded at every step based on efficiency/deficiency of data entered, e.g., if persons diet routine is healthy then negative points are awarded which are ultimately impacting positive affect in person's health. In the end application calculates the final score and compares it with person's chronological age. The complete work flow of Life style Application is shown in Figure 3.4. Beginning with prototype, it comprises of following components.
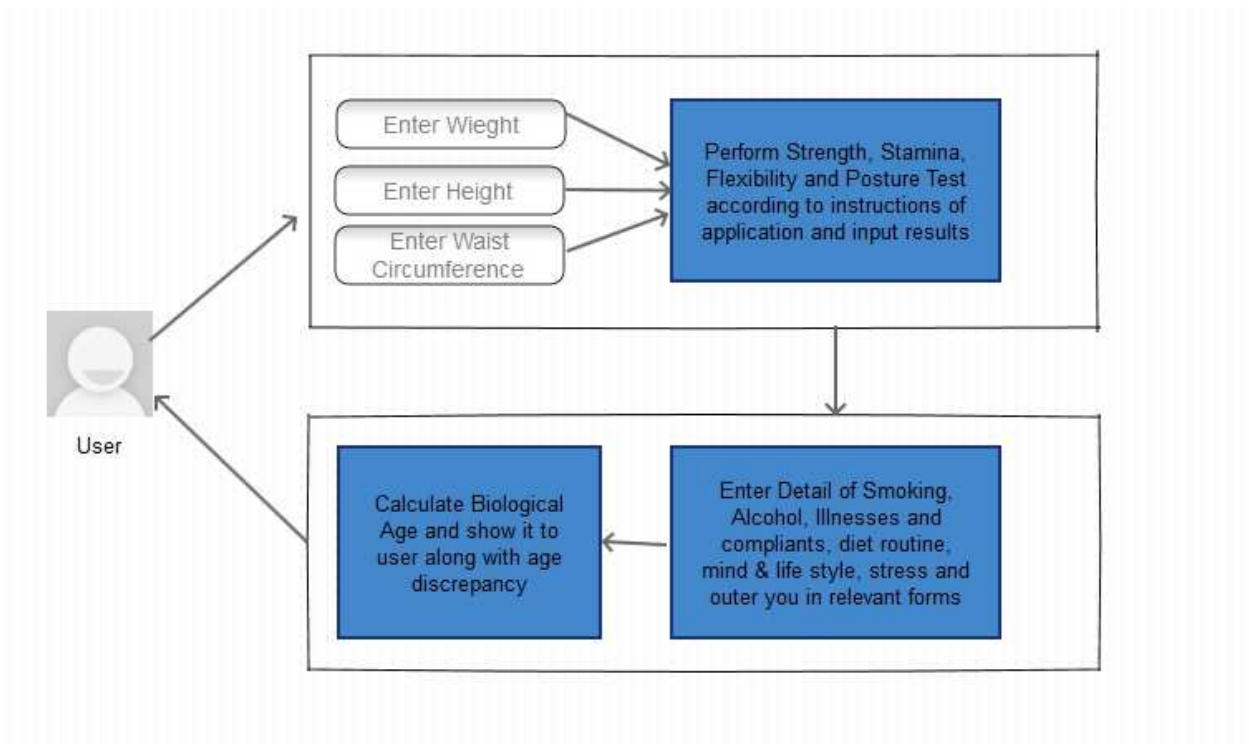
Figure 3.4: LifeStyleApp's WorkFlow

- User is required to input weight(kg), height(m) and waist circumference(inches) at first step.

- Application shall guide user to perform/do some physical activities which are required to evaluate cardiovascular risk.

- Daily routine of each user will also be required to input.

- In the end, application applies scoring system on all input parameters and calculates fitness score to show to the customer.

Following are the screenshots to input health related parameters.

Figure 3.5: LifeStyleApp's Interface for General Health Check

Figure 3.6: LifeStyleApp's Interface to input diet routine

Figure 3.7: LifeStyleApp's Interface to input Mind & Life Style

Chapter 4

Results and Discussion

This chapter presents results of all techniques applied in this research. Results were discussed in the end.

4.1   Sample Characteristics

Total 160 people participated in the camp, 6 of which are excluded while analysis due to inclusion criteria of age>25 years. NUST is located in federal location, so all were Pakistani people and belong to different part of Pakistan. Chronological age of sample was between 26-67.

4.2   Data Preprocessing

None of the record was found missing in the data set. Data was encoded as per standards of SPSS. Normalization was performed on all data before analysis to make is linearly distributed. None of the participant reported to using alcohol/drugs so this was excluded during analysis. Weight and height was used for computation of BMI so only BMI was included for analysis. All features of data set are mentioned in Table 4.1 along with description and possible values of each feature.

Table 4.1: Independent Variables Examined for Analysis

Variable	Description	Value
Weight	Continuous	
Height	Continuous	
Chronological age	Continuous	
Waist circumference	Continuous	
Body mass index	Continuous	
Stamina	Likert scale	-You found the exercise easy and feel fine -Moderately hard and are fairly out of breath -Hard and are very out of breath -Very hard and are extremely out of breath -Too hard and couldnt complete the 3 minutes
Strength	Likert scale	Over 30 21-30 14-20 7-13 Less than
Flexibility	Likert scale	Beyond toes To toes but no further No further than mid lower leg
Posture	Binary	Yes No
Smoking	Likert scale	None 1-20 20+
Illnesses and Complaints	Likert scale	0 to +7 +8 to +14 +15 or more
Diet	Likert scale	-10 to -6 -5 to 0 +1 to +2 +2 to +5 +6 to +10
Mind and Life Style	Likert scale	-6 to -11 -1 to -5 0 +1 to +5 +6 to +11
Stress	Likert scale	-4 to -6 -1 to -3 0 +1 to +3 +4 to +6
Outer You	Likert scale	Under 2 +2 to +4 +5 to +8

4.3 Statistical Data Analysis

All data was analyzed using IBM SPSS Statistics 20. The mean and standard deviations of continuous variables i.e., weight, height, body mass index, waist circumference, chronological age and QRISK risk probability is mentioned in Table 4.2.

Table 4.2: Mean and Standard Deviation of Continuous Variables

Variable	N	Mean	Std. Deviation
Weight	154	74.4797	12.30772
Height	154	1.6874	.06612
BMI	154	26.3085	3.44997
Waist Circumference	154	36.5974	3.98120
Chronological Age	154	40.9416	11.38827
QRISK Probability	154	13.346	20.8879

Probability of cardiovascular diseases is calculated by using QRISK interventions. It is a continuous variable. Relationship of probability with other continuous variables is evaluated by running bivariate correlations on data. Outcome variable, probability of cardiovascular diseases is also continuous.

4.4 Techniques Applied

Different techniques applied to achieve the results are as as follow

- Correlation to check association of all CVD risk factors with outcome variable i.e QRISK probability

- Principal component analysis to extract important CVD risk factors

- Multiple Linear Regression to create prediction model.

4.4.1 Analysis for Specific Research Questions

Research Question 1.0: Which are modifiable life style factors which could be strongly correlated with cardiovascular diseases?

RQ1 Hypothesis 0: Life style factors have no significant effect on cardiovascular diseases.

The Alternative Hypothesis was defined as follows:

RQ1 Hypothesis 1: Life style factors have significant effect on cardiovascular diseases.

Analysis 1: Spearman correlation was applied to find the relationship between outcome variable(QRISK probability) and all continuous variables. Continuous variables include weight, height, body mass index, waist circumference and chronological age. Correlation shown in Table 4.3 reveals that as chronological age, waist circumference and BMI increases, probability of cardiovascular diseases also increases.

Table 4.3: Correlation of Continuous Predictors with Cardiovascular Risk Score/Probability

Variable	r	P
Weight	0.259	<0.01
Height	0.029	>0.01
BMI	0.266	<0.01
Waist Circumference	0.507	<0.01
Chronological Age	0.814	<0.01

One-Way ANOVA was applied to check the significance level of Ordinal variables on cardiovascular probability and results are presented in Table 4.4

Table 4.4: Correlation of Ordinal Variables with Cardiovascular Risk Probability

Variable	Sig.Value
Stamina	>0.01
Strength	<0.01
Flexibility	>0.01
Posture	>0.01
Smoking	>0.01
Illnesses and Complaints	>0.01
Diet	>0.01
Mind and Life Style	>0.01
Stress	>0.01
Outer You	>0.01

Above table shows that only strength showed significant relationship with outcome variable i.e., QRISK probability. All other features were unrelated to outcome variable.

Analysis 2: Principal component analysis (PCA) was applied to figure out maximum effects features. BMI, Waist Circumference, Age and Strength showed maximum variance and it can be depicted in below graph. Rest of features were clustered into two groups. One Group contains Smoking, Outer, General illnesses, Posture and Stamina. Rest of the four features i.e., Diet, Mind and life style, Stress and Flexibility were grouped in second cluster.

Figure 4.1: PCA

X-axis showing first principal component and Y-axis showing second principal component.

Research Question 2.0: How can modifiable life style factors be used to predict cardiovascular risk probability?

RQ2 Hypothesis 0: Life style factors have significant effect on cardiovascular diseases but can not be used solely as initial predictors of cardiovascular risk probability.

The Alternative Hypothesis was defined as follows:

RQ2 Hypothesis 1: Life style factors have significant effect on cardiovascular diseases and can be used solely as initial predictors of cardiovascular risk probability.

Analysis: Multiple linear regression was applied on the significant features extracted above by applying Principal Component Analysis(PCA). Regression equation was determined with R Square value 72.9. One representative feature from other clusters was also picked for regression. The model summary of Regression is given below in Table 4.5

Table 4.5: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.854	.729	.717	.38409

Above model summary represents that CVD risk can be measured upto 72.9% accuracy by including six most significant predictor variables. Parameter table of regression equation is also mentioned below in Table 4.6

Table 4.6: Parameter Estimates

Variable	Coefficient	Standard error	Significance
Chronological Age	5.045	.323	0.000
Waist Circumference	2.149	0.900	.018
BMI	-.027	0.127	.833
Smoke	-.503	0.250	0.046
Diet	.252	.150	.095
Strength	.154	.125	.221
Constant	-10.358	1.170	0.000

Equation of regression is
Regression(Probability)=-10.358+(0.027*BMI)+(2.149*WAIST)+(0.154*Strength)+(-0.503*Smoking)+(0.252*Diet)+(5.045*Age)

4.5 Discussion on Results

For this study, we recruited staff of NUST. People were belonging from different parts of country because of national institute. Total 160 people were part of the study, but 6 of them were students and excluded due to inclusion criteria of age (age>25). Average CVD risk of studied population was 13.3% which shows medium risk people were part of the study. Among 154 participants, 95 were ranked low risk, 27 medium and remaining 32 as high risk according to QRISK Intervention. None of the participant was reported to be using drugs/alcohol. In fact, none of the them was chain

smoker as well. On average, studied population was overweight because average BMI was 26 kg/m2. Total 63 were overweight and 8 were obese who had BMI>30. Waist Circumference is also recommended to use with BMI to check disease association. Average waist circumference was 36.59 inches (92.94 cm) and as male were part of the study so it was also showing healthy measurement because for male risk is increased when circumference is 94 cm or above it [1]. 86% participants reported that stamina exercise is easy to perform and they performed it for consecutive 3 minutes without getting out of breath. Strength test was little difficult for people and majority people were able to do 7 to 13 press ups in one go. Very few were able to do above 30 press ups. Participants were following healthy diet routine without any prior medical knowledge. Stress was also at very low level in studied population. Outer characteristics of all participants were also in good position. 89.6% people were reported to have all outer properties in original and good form.

Chapter 5

Conclusion

This chapter concludes whole thesis and describes the limitation of this research. Future of this research is also mentioned in this chapter.

5.1 Conclusion

Results revealed that chronological age, waist circumference and BMI showed significant effect on cardiovascular diseases risk in targeted populations.It was expected result because mostly people were healthy and due to sedentary life style,mostly people were overweight. It is already shown in many literature that as age increases, risk of heart related issues also increase. Strength test from physical activities shown strong effect on cardiovascular risk score. Different motivational programs can be started in institutes to promote physical activities during work hours to keep people active. Long sitting hours results physically inactive and obesity which ultimately cause heart related issues. Smart phones are very common these days so different games can be developed to track whole day activities and monitor progress if person is well maintaining health activities. A big scale study is required further which can be helpful to prove the results.

5.2 Future Work

Sample size was small(N=154). Very few heart patient were part of this study. Mostly people were healthy or at medium risk of cardiovascular diseases. Only Male were part of the study due to which results were based on Male participants only. We can look further for a large scale study which includes both male and female participants to further prove the results.

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