

RESEARCH ARTICLE

Profile of Non-Communicable Disease Risk Factors Among Employees at a Saudi University

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Abstract

Background: There is paucity of studies defining the prevalence of non-communicable disease (NCD) risk factors in Saudi Arabia despite the surging epidemic of obesity, change in dietary habits and sedentary lifestyle. **Objectives:** This cross-sectional study aimed to assess the prevalence of NCDs risk factors among employees at King Faisal University in Al Hassa, Saudi Arabia and to determine the possible correlates for clustering of NCDs risk factors among them. **Materials and Methods:** All employees were invited to participate; the World Health Organization STEPwise approach was used for data collection which consisted of a personal interview to collect socio-demographic characteristics, NCD history, tobacco use, vegetables and fruit consumption, and physical activity (PA), followed by anthropometric measurements namely weight, height and waist circumference and blood pressure measurements, subjects were finally subjected to biochemical tests with determination of fasting plasma glucose, serum triglycerides, cholesterol and high density lipoproteins. **Results:** Of the surveyed employees (n=691), daily current smokers accounted for 22.7%. 94.9%, 95.1% and 86% consumed < 5 servings per day of vegetables, fruits and both fruits and vegetables respectively, 73% were physically inactive, 64% were overweight or obese, 22.1% had hypertension, and 21.5% were diabetics. Elevated cholesterol levels were found in 36.6%, low high density lipoproteins in 36.8%, and elevated triglycerides in 36.1%. Only 3% had no NCD risk factors, and 57.6% had ≥ 3 factors. Multivariate logistic regression showed that gender (being male, adjusted odds ratio 'aOR'=1.51), aged ≥ 50 years (aOR=3.06), < college education (aOR=1.75), current smokers (aOR=2.37), being obese (aOR=6.96) and having a low PA level (aOR=4.59) were the significant positive predictors for clustering of NCD risk factors. **Conclusions:** Over fifty percent of the studied university's employees had multiple (≥ 3) NCD risk factors. Screening and health promotion initiatives should be launched at least targeting the modifiable factors to avert the excessive risk for cardiovascular disease, diabetes mellitus and several types of cancers.

Keywords: Non-communicable diseases - risk factors - STEPwise - university employees - Saudi Arabia.

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Introduction

Of the 36 million deaths from non-communicable diseases (NCDs) worldwide in 2008 (W.H.O., 2012), 7.6 million ($\approx 20\%$) were due to cancer. The global cancer incidence is projected to increase from 13.3 to 21.4 million per year between 2010 and 2030 (Ferlay et al., 2010). By 2030, approximately half of all cancers globally will occur in low and middle income countries (W.H.O., 2012). The important known risk factors for NCDs are high blood pressure, high serum cholesterol, excess weight, inadequate vegetables and fruits intake, physical inactivity (PinA) and tobacco use. These factors are interrelated having multiplicative effect with involvement of NCDs even in a person with modest elevation of several risk factors (Murray and Lopez, 1996). The shared environmental and behavioral risk

factors for NCDs made an important contribution to the global cancer burden (Lim et al., 2010; Wild, 2012). The global impact of tobacco with cancer in multiple organs (Cogliano et al., 2011), the linked association between insufficient PA and breast, colorectal and endometrium cancers are well recognized (AICR, 2007). Also, reducing the consumption of sugar should help control obesity and overweight, which are risk factors for cancers of the esophagus, breast, colorectum, endometrium, kidney, and pancreas (AICR, 2007). NCDs especially cardiovascular, cancer, and type 2 diabetes mellitus are accounting for >50% of all deaths and disability adjusted life years lost in the Eastern Mediterranean Region including the Gulf states (Musaiger and Al-Hazzaa, 2012).

Future projections of NCD prevalence rates might reach epidemic proportions, with serious consequences on mortality, productivity and health-care expenditure

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(Zaghloul et al., 2011). The burden of these diseases is particularly high in Arab countries including Saudi Arabia (Hazzaa et al., 2011). Saudi Arabia is witnessing a rapid economic advancement in the recent decades. This advancement is coupled with change in the socio-economic structure and change in the population's lifestyle reflected in more sedentarism and adoption of westernized eating habits (Amin et al., 2014), with the emergence and abundance of NCDs risk factors in the form of physical inactivity and unhealthy dietary habits, most of NCDs including various types of cancers are showing disproportionate increase in Arab Gulf countries including Saudi Arabia (W.H.O., 2001). Prevention of many NCDs including cancers stemmed from the control of modifiable risk factors, therefore primary prevention of these risk factors through identification and appropriate management may help in delaying and halting the progression of many NCDs (Wild, 2012). There is paucity of studies that defined the prevalence of NCDs risk factors in Saudi Arabia despite the surging epidemic of obesity, changing in dietary habits, sedentarism especially among those more likely at risk by the virtue of age, occupational status like universities' employees. The objectives of this study were to identify the prevalence of NCDs risk factors among the employees at King Faisal University in Al Hassa and to determine the possible predictors for clustering of NCDs risk factors among them.

Materials and Methods

Setting and design

King Faisal University is located in Al-Hassa Governorate, Eastern Province of Saudi Arabia and 450 Km from Riyadh. The University encompasses ten colleges with a total manpower accounted for 2393 (year 2012), 790 women and 1603 men at various occupational categories (staff, management, clerical) and technical services. The employed population, their families and students receiving primary care services through a medical center located within the campus.

Subjects and methods

A cross sectional descriptive study in which all university's employees were eligible. Over four weeks duration employees were invited through multiple channels including; announcements on University's website, personal approach, and banners posted in administrative premises including health center and colleges, with distribution of brochures explaining the objectives, procedures, inclusion and exclusion criteria, the locations and dates assigned for each college and administrative facilities within the university campus for the study also announced and circulated within the campus. Participants' agreement and fasting for 10-12 hours were the inclusion criteria, being pregnant and the presence of conditions hindered PA seven days prior the interview were the exclusion criteria.

Data collection

World Health Organization STEPS methodology (W.H.O. STEP wise approach for Surveillance of Chronic

Non-communicable Diseases Risk Factors, version 3) (<http://www.who.int/chp/steps/instrument/en/index.html>) was employed for data collection. The STEPS instrument covers three different levels or 'steps' of risk factor assessment: Step 1 (questionnaire), Step 2 (physical measurements) and Step 3 (biochemical measurements). This method provided a validated framework for the surveillance of NCDs risk factors (W.H.O., 2002). STEPS is composed of several tools to gather information regarding socio-economic and behavioral risk profile, anthropometry, blood pressure measurements and biochemical testing including fasting blood sugar and lipid profile. The available Arabic version of the STEP was used for data collection.

Data collection spanned from 1st of March 2012 to May 30th 2012. Ten trained interns (5 males and 5 females) on data collection (training included conduction of personal interview, data collection about the socio-demographic and behavioral risk factors: tobacco use, PA and dietary habits, and the use of show cards (two were designed, one to assist participants in responding about the consumption of fruits-vegetables available and the second to illustrate different PA patterns along work-and leisure -related domains suitable to Saudi culture). Two technicians (one male and one female) were trained for anthropometric and blood pressure measurements using standardized protocol with frequent calibration of the instruments used. The data collection procedures included the following:

Step I personal interview with STEP questionnaire

Socio-demographic data: age, education, nature of work within the university, residence and marital status.

Disease history: hypertension, diabetes mellitus, cardiac event or other vascular diseases with detailed inquires regarding age at diagnosis, follow ups and medications.

Tobacco use: current smoking status, forms of tobacco usage, duration of smoking, age at initiation and frequency.

Vegetables and fruit consumption in terms of frequency of consumption/week and average servings/day, with demonstration of serving size of different food items using a show card.

PA along different domains of work-commuting- and-leisure related was obtained using the Global Physical Activity Questionnaire (GPAQ).

Step II Anthropometry and blood pressure measurements

Weight was measured using commercial scale "Seca, Germany" with an accuracy of ± 100 Kg. Subjects were weighed barefooted and with minimal clothes. Scales were re-calibrated after each measurement.

Height was measured using commercial stadiometer, subjects were barefooted, with shoulders relaxed, and arms hanging freely. Height was approximated to the nearest 0.5cm. Body mass index (BMI) was calculated "Body weight in kg/Height in square meters".

Waist circumference was measured in centimeters using a measuring tape passing midway between the iliac crest and the lower costal margin.

Blood pressure was measured using OmRon sphygmomanometers (HEM-907XL) after fulfilling

American Heart Association blood pressure measurement protocol (Pickering et al., 2004). Both systolic and diastolic pressures were measured at two occasions and the averages were recorded. Participants reporting current use of anti-hypertensive drugs were considered hypertensive regardless their blood pressure readings.

STEP III Biochemical tests

Finally all subjects were submitted to biochemical tests, blood samples were taken after sitting for at least 15 minutes and from the counter arm used for blood pressure measurement by two laboratory technicians (one male and one female). Venous blood samples were taken in the morning after twelve hours of fasting for determination of fasting plasma glucose (FBG) using glucose peroxidase method, also, serum triglycerides and cholesterol were measured using standard enzymatic procedures and high density lipoproteins were assessed by direct assay method. Subjects were considered having impaired glucose level if FBG was 110-125mg/dl. Subjects with FBG \geq 126mg/dl and those using medication to control diabetes were considered diabetics. For cholesterol level; borderline high if it was \geq 190mg/dl, high (\geq 240mg/dl), triglycerides \geq 150 was considered borderline high, and high if it was \geq 180mg/dl, and low high density lipoproteins level was considered if it was $<$ 40mg/dl in men and $<$ 50mg/dl in women (W.H.O. STEPwise approach). All biochemical tests were carried out at the University's Health Center.

Data analysis

Out of the total university's employees invited, 792 responded and agreed to participate (33.1% response rate), 269 women (34.1% response rate) and 523 men (32.3% response rate). Forms with missing of \geq 2 items (n=36), refused anthropometric assessment (n=21) or declined blood sampling (n=44) were excluded from the final analysis, 691 were the total eligible forms for final analysis. Data entry and analysis were carried out using SPSS 13.0 (SPSS Inc. Chicago, U.S.A.) and Epi-Info version 6.04 (Centers for Disease Control and Prevention, Atlanta GA., U.S.A) and analysis was performed according to STEP protocol. Categorical data were expressed in frequency and proportions, employing Chi square and trend analysis as appropriate. Continuous data were expressed using median, interquartile range (IQR), mean and standard deviations, t-test, Mann Whitney and Kruskal Wallis tests were used for comparison when indicated. PA was classified according to the GPAQ protocol into high, moderate and low PA categories (W. H.O, STEPS Instrument, version 3.0). The total metabolic equivalents (METs) of PA after applying tests of normality, namely Kolmogorov-Smirnov test revealed a statistic of .431 (p=0.001). The previous figure rejected data normality, and hence we employed 95% confidence intervals (CI) for the median (50th percentiles) using method proposed by Bonett and Price (Bonett and Price, 2002) and IQR, to report PA in METs-minutes. Possible determinants for clustering of NCDs risk factors were assessed through generating an adjusted multivariate logistic regression model using the number of NCDs risk factors (dependent dichotomy of $<$ 3 vs \geq 3), namely low

PA of $<$ 600 METS/minute/week, current daily smoking, obesity with BMI of $>$ 29.9, consumption of fruits and vegetables $<$ 5 servings/day, hypertension $>$ 140/90mmHg, FBG $>$ 126mg/dl, and the presence of dyslipidemia [cholesterol \geq 240mg/dl, triglycerides of \geq 180mg/dl and/or low high density lipoproteins] with socio-demographic and other independent variables significant at univariate analysis and expressed in the form of Odds ratio with 95% confidence intervals. p value of $<$ 0.005 was considered significant.

Ethical considerations

Permissions were obtained after approval of the study protocol and data collection forms. Participants signed an informed consent form after detailed orientation about the objectives, procedures and possible outcomes of the study. Two forms were designed, one for reporting the biochemical tests' results, and one for referral to the University's medical center in case of abnormal biochemical findings and/or behavioral risk factors for medical consultation and counseling.

Results

Basic characteristics

Table 1 demonstrates the socio-demographic characteristics and chronic diseases history among participants distributed by gender. A total of 691 participants, their age ranged from 24 to 63 years. Age category 30 to $<$ 50 years constituted 62.3% of participants and women constituted less than a third (28.7%), and were relatively younger. Saudis constituted 76.8%, Arab non-Saudis 18.6% (Egyptians, Sudanese, Tunisians, Syrians, Algerians, and Jordanians) and 4.6% were non Arabs; namely Indians, Pakistanis, and Bangladeshi nationals. Faculty constituted 36.6%; Saudis 32.8% and Arab non-Saudis and non-Arabs accounted for 67.2%. Hypertension was diagnosed in 13.5% (15.0% and 9.6% of hypertensive men and women respectively) reported non-compliance to medications. Nine percent were diagnosed as having diabetes mellitus type 2, 11.4% mentioned non-compliance to treatment, and 3.0% had concurrent diabetes and hypertension, and 1.9% with history of coronary heart disease. Saudis and Egyptians were proportionately more affected with NCDs compared to other nationalities as they accounted for 76.8% of those diagnosed cases. Those occupying administrative jobs were more likely to have NCDs as they constituted 54.0% of the diagnosed diabetics, 50.0% of hypertensive, and 70.0% with coronary heart disease while faculties constituted 20.0% of diabetics, 32% of hypertensive, and 30.0% of coronary heart disease.

Smoking and alcohol intake

None of the participants stated alcohol consumption and none of the women included reported tobacco smoking in any form. Of the included men, 36.1% reported 'ever tried cigarette smoking. Occasional smoking (during social gatherings and other social events) was mentioned by another 3.9%. Current daily smokers accounted for 22.7% (95%CI=19.2-26.6) of which 59.5% were using

Table 1. Socio-Demographic and Health Characteristics of Participants in Relation to Genders, King Faisal University, Saudi Arabia

Characteristics	Gender: No. (%)		Total (N=691) No. (%)
	Females (N=198)	Males (N=493)	
Age in years: Median	38.5	40	40
Mean ± SD	37.5±8.5	41.9±10.0	40.4±9.8
Age groups (years):			
< 30	31(15.7)	88 (17.8)	119(17.2)
30-<40	68(34.3)	126(25.6)	194(28.1)
40-< 50	67(33.8)	169(34.3)	236(34.2)
50-63	32(16.2)	110(22.3)	142(20.5)
Nationality:			
Saudis	167(84.3)	364(73.8)	531(76.8)
Arabs non Saudi	31(15.7)	97 (19.7)	128(18.6)
Non Arabs	--	32 (6.5)	32 (4.6)
Residence:			
Urban	167(84.3)	425(86.2)	592(85.7)
Rural	31 (15.7)	68 (13.8)	99 (14.3)
Educational status:			
Primary/preparatory	25 (12.6)	84 (17.0)	109(15.8)
Secondary	44 (22.2)	166(33.7)	210(30.4)
College or higher	129(65.2)	243(49.3)	372(53.8)
Job within the University:			
Faculty	78 (39.4)	175(35.5)	253(36.6)
Administrative	91 (46.0)	222(45.0)	313(45.3)
Technicians	24 (12.1)	77 (15.7)	101(14.6)
Others!	5 (2.5)	19 (3.8)	24 (3.5)
Marital status:			
Married	137(69.2)	418(84.8)	555(80.3)
Single	49 (24.7)	69 (14.0)	118(17.1)
Divorced/widowed	12 (6.1)	6 (1.2)	18 (2.6)
Chronic comorbidities:			
Diagnosed hypertension	34 (17.2)	59 (12.0)	93 (13.5)
Diagnosed diabetes	8 (4.0)	56 (11.4)	64 (9.3)
Diabetic and hypertensive:	4 (2.0)	14 (2.8)	18 (2.6)
History of coronary heart disease	--	13 (2.6)	13 (1.9)

*SD= Standard deviation. Others includes: agricultural and maintenance engineers, safety and security officers, drivers, and auxiliary workers

cigarettes, 37.4% were smoking shisha, 3.1% smoking both. Current smokers were more among 30 - <40 years age group, 75% of the current daily smokers were Saudis, 18% were Arab non Saudis, and 7% non-Arabs. About 52% of the current smokers were occupying administrative jobs, 17.0% were faculty and 31.2% technical and assistant staff. The number of cigarettes smoked/ day was higher among those aged ≥ 40 years, while the number of shisha bowls/day was more among those aged ≤40 years.

Vegetables and fruits servings/day

The median (mean) servings of vegetables, fruits and both vegetables & fruits per day in the last seven days was 2.0 (mean=1.8, CI=1.7-2.0), 1.0 (0.9, CI=0.8-1.1) and 3.0 (3.9, CI=2.7-3.1) respectively. The median servings of vegetables, fruits and vegetables & fruits in the last 7 days among men was 2.2 (mean=2.0, CI=1.9-2.4), 0.5 (0.9, CI=0.9-1.0) and 2.5 (2.8, CI=2.6-3.2), higher for vegetables and fruits and vegetables consumption compared to women of 1.0 (mean=1.3, CI=1.0-1.5), 1.0 (1.0, CI=0.8-1.3) and 2.0 (2.3, CI=1.9-2.6) respectively but without statistical difference. Of the sampled population, 95.1%, 94.4% and 86.0% received <5 servings/day of vegetables, fruits and vegetables & fruits respectively. Only 5.1%, 4.9% and 14% of participants consumed ≥5 servings /day of vegetables, fruits and fruits and vegetables/day respectively (Figure 1). No significant difference regarding the number of servings of fruits and vegetables/day in relation to age or genders but to nationalities as 16.4% and 14.1% of Arab non-

Saudis consumed ≥5 servings of vegetables and fruits/ day compared to Saudis (only 2.1% and 2.2% consumed ≥5 servings of vegetables and fruits/ day respectively).

Physical activity (PA)

Figure 2 shows the PA in METs minutes/week in relation to genders. The median total METs minutes/week for all domains was of 1327 (CI for the median=58.8-1329, IQR=1097) significantly higher among men (median of 1391, CI=67-1133, IQR=1209), compared to women 1191 (CI=24-1211, IQR=983) (p=0.012). The total work-related METs minutes /week with a median of 908 (CI=31-932, IQR=814) more among women (median of 996 compared to men of 788 METs minutes/week). Those aged 30 to <40 years of both genders showed the highest work-related METs (median=1410, CI=58-1880 in men and 1184, CI=91-1348 in women), statistically significant only among men in relation to other age groups, Kruskal Wallis, p=0.011). Those aged 20 to <30 years showed the highest leisure-related PA (median=668, CI=121-890 in men, and 259 (CI=42-279) in women, only statistically different among men’s age groups (Kruskal Wallis, p=0.003). Commuting or transport-related PA accounted for the least METs among both genders (480 METs minute/week in men and 324 METs minutes/week for women). Of the total participants, 3.8% of participants (CI=2.6-5.5) were categorized as having high PA level (3.7% in men vs 4.0%

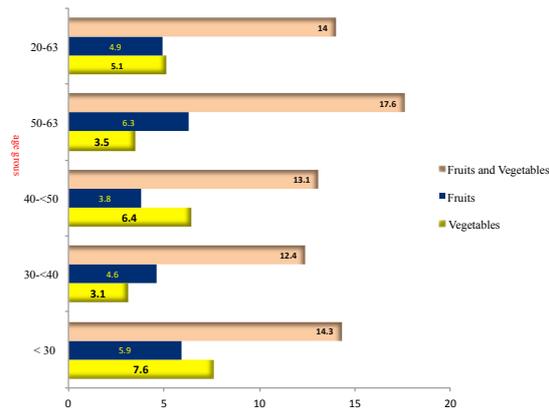


Figure 1. Percentage of ≥5 Servings/day of Fruits and Vegetables among the Sampled King Faisal University Employees in Relation to Age Groups

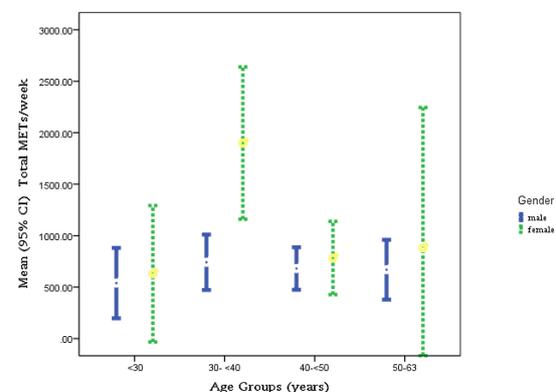


Figure 2. Mean (95% Confidence Intervals) of Total Metabolic Equivalents (METs Minutes/week) in Relation to Age Groups and Genders among the Sampled King Faisal University Employees

in women). A total of 160 (23.2%, CI=20.1-26.4) were in the moderate PA category. Those in the low PA category constituted 73.1% (CI=69.7-76.3) with no significant differences in relation to gender or age groups. Saudis were more likely to be in the low PA category (71% of those with low PA) compared to other nationalities (68.6% of Arab non Saudis, and 58.3% of non Arabs, $p=0.033$). Thirty three percent of non Arabs were in the moderate PA category compared to Saudis and Arab non Saudis (21% and 27% respectively). Faculty members were the least active as 76% of them showed low PA level compared to 67% of administration staff and 71% of the technical/assistant staff.

Overweight and obesity

Figure 3 displays BMI categories of the studied employees in relation to age groups. The mean total BMI was 28.3(CI=25.8-29.7), higher among women than men (29.1,CI=27.2-30.1 vs 27.8,CI=25.7-29.6 in men). Those with desirable BMI of <25 constituted 35.9% more among men (37.7% vs 31.3% of women). Overweight (BMI=25-29.9) accounted for 33.3%, significantly more among women 38.4% compared to men (31.0%) ($p=0.036$). Obesity was encountered in 30.7% (CI=27.2-34.1). Grade I (BMI=30-34.9) and II (BMI \geq 35) were found in 18.2%

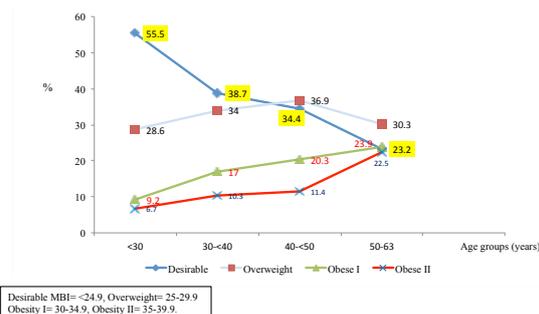


Figure 3. Body Mass Index Distribution by Age Groups among the Sampled King Faisal University Employees

and 12.3% of the studied population respectively with a significant increased trend of grade I obesity in relation to age in both genders. More than 80% of obese individuals were Saudis, 17.2% were Arab non-Saudis and 2.1% were non Arabs. Obesity was more among administrative staff (60.0%) followed by faculties (20.4%), then technical and other jobs (19.6%). The mean waist circumference (WC) in men was 101.9 \pm 16.4 cm (CI=98.5-105.2), and 40.0% of men had a WC >102cm. The mean WC in women was 91.7 \pm 16.5 cm (CI=89.4-101.8) and 46.5% of women had a WC >88 cm.

Hypertension and elevated blood glucose

Table 2 displays the mean systolic and diastolic blood pressure among participants in relation to genders and age. Those with a history of HTN constituted 16.1% (15.2% of men vs 18.2% of women). New cases with systolic HTN (\geq 140mmHg) were detected in 6.5%, diastolic HTN (\geq 90 mm) in 4.9% and systolic & diastolic HTN (\geq 140/90mmHg) in another 6.1%. Overall, 22.5 % of men and 21.2% of women had HTN (previously diagnosed and those newly detected during the study). Table 7 also depicts the mean FBG among participants by age groups and genders, 14.2% were found to have FBG \geq 110mg/dl, more among men (16.8% vs 7.4% in women, $p=0.006$). A total of 69 (9.9%) participants had fasting blood sugar >126mg/dl and not diagnosed before as having diabetes 55 (11.2%) men and 14 (7.1%) women.

Lipid profile

Table 3 demonstrates the mean levels of cholesterol, high density lipoproteins and triglycerides in relation to genders and age groups. For cholesterol, 21.3% had borderline high (\geq 190mg/dl) and 15.3% had high levels (\geq 240mg/dl). Borderline high level was found in 21.3% of men and 21.2% of women, while high cholesterol was significantly more in women (20.2%) than men (13.4%) ($p=0.014$). Low high density lipoproteins (HDL) (<50mg/

Table 2. Blood Pressure Measurements, Hypertension, Elevated Blood Pressure and Blood Glucose Measurements among the Participants. King Faisal University, Saudi Arabia

Age groups and gender	Systolic Mean (95%CI)	Diastolic Mean (95%CI)	Diagnosed hypertension No. (%)	Hypertension: at screening No. (%)			Blood sugar Mean (95%CI)	Fasting blood sugar No. (%)	
				Both	Systolic	Diastolic		Raised blood sugar*	Diagnosed diabetes
Men (N=493)									
20-<30 [n=88]	111.3(101.8-120.7)	73.8(64.9-82.6)	1 (1.1)	4 (4.5)	4(4.5)	4 (4.4)	86.9(79.8-94.0)	3 (3.4)	2 (2.3)
30- <40 [n=126]	120.0(115.1-124.9)	80.6(77.4-83.7)	16(18.2)	9(10.2)	7(8.0)	5 (5.7)	93.3(85.4-101.2)	13(10.3)	10 (7.9)
40- <50 [n=169]	120.3(116.7-123.9)	81.6(78.6-84.7)	37(29.4)	10 (7.9)	8(6.3)	16(12.7)	97.1(90.6-103.7)	34(20.1)	29(17.2)
50-63 [n=110]	126.3(119.7-132.8)	83.7(77.8-90.4)	21(19.0)	13(11.8)	10(9.1)	12(10.9)	108.5(95.9-111.0)	33(30.0)	27(24.5)
Total	123.3(121.9-124.9)	79.2(78.2-83.3)	75(15.2)	36 (7.3)	29(5.9)	37 (7.5)	100.7(95.7-105.7)	83(16.8)	68(13.8)
Women (N=198)									
20-<30 [n=31]	114.8(112.2-117.4)	69.1(67.4-70.8)	1 (3.2)	-	-	-	76.5(72.5-80.6)	-	-
30- <40 [n=68]	121.6(117.0-126.1)	77.9(73.3-82.6)	6 (8.8)	2(2.9)	-	-	82.1(75.6-88.6)	3 (4.4)	3 (4.4)
40- <50 [n=67]	123.9(119.5-128.4)	79.2(75.7-82.8)	16(23.9)	1(1.5)	5(7.5)	8(11.9)	81.1(73.8-88.4)	6 (9.0)	8(11.9)
50-63 [n=32]	125.9(119.9-131.8)	74.9(70.9-78.8)	13(40.6)	3(9.4)	-	-	100.5(65.3-135.7)	6(28.1)	1 (3.1)
Total	121.2(118.8-123.6)	76.2(74.0-78.4)	36(18.2)	6(3.0)	5(2.5)	8 (4.0)	81.8(77.6-86.3)	15 (7.4)	12 (6.1)
Total (N=691)									
20-<30 [n=119]	111.3(101.8-120.4)	73.8(64.9-82.6)	2 (1.7)	4(3.4)	4(3.4)	4 (3.4)	83.8(78.6-88.9)	3 (2.5)	2 (1.7)
30- <40 [n=194]	120.0(115.1-124.9)	80.6(77.4-83.7)	22(11.3)	11(5.7)	7(3.6)	5 (2.6)	90.1(84.2-96.1)	16 (8.2)	13 (6.7)
40- <50 [n=236]	120.3(116.7-123.9)	81.6(78.6-84.7)	53(22.5)	11(4.7)	13(5.5)	24(10.2)	93.8(84.3-99.2)	40(16.9)	37(15.7)
50-63 [n=142]	126.3(119.7-132.8)	83.8(77.1-90.1)	34(23.9)	16(11.3)	10(7.0)	12 (8.5)	106.8(105.1-128.5)	39(27.5)	28(19.7)
Total	120.0(121.8-127.1)	80.0(77.5-81.4)	111(16.1)	42(6.1)	34(4.9)	45 (6.5)	86.0(92.0-99.9)	98(14.2)	80(11.6)

Systolic hypertension= \geq 140mmHg, diastolic hypertension = \geq 90mmHg. Fasting blood sugar \geq 110mg/dl

Table 3. Lipid Profile of the Surveyed King Faisal University's Employees in Relation to Age Groups and Gender

Age groups and gender	Total cholesterol Mean (95%CI)	Cholesterol level ^a : No. (%)		High Density lipoproteins* Mean (95%CI)	Low HDL ^b levels No. (%)	Triglycerides Mean (95%CI)	Triglycerides level ^c : No. (%)	
		High	Borderline				High	Borderline
Men (N=493)								
20-<30 [n=88]	172.7(162.2-183.3)	6(6.8)	9(10.2)	56.3(48.9-73.7)	14(15.9)	127.4(106.5-148.3)	7(8.0)	26(29.5)
30- <40 [n=126]	176.9(168.6-185.1)	11(8.7)	32(25.4)	54.7(49.6-69.9)	32(25.4)	136.3(116.6-242.2)	17(13.5)	28(22.2)
40- <50 [n=169]	181.0(174.7-187.3)	28(16.7)	38(22.5)	45.8(38.9-62.6)	82(48.5)	130.7(115.4-145.9)	21(12.4)	32(18.9)
50-63 [n=110]	181.8(171.5-194.1)	21(19.1)	26(23.6)	42.1(31.1-55.0)	64(58.2)	114.0(99.1-128.8)	9(8.2)	18(16.4)
Total	178.9(174.5-186.5)	66(13.4)	105(21.3)	45.5.8(40.9-64.7)	192(38.9)	126.8(118.4-135.2)	54(11.0)	104(21.1)
Women (N=198)								
20-<30 [n=31]	173.6(153.4-193.8)	3(9.7)	6(19.4)	63.2(34.6-71.8)	7(22.6)	148.0(133.8-232.2)	7(22.6)	7(22.6)
30- <40 [n=68]	212.3(168.6-231.3)	19(27.9)	13(19.1)	44.5(36.2-54.7)	32(47.1)	191.7(159.4-263.0)	29(42.6)	21(30.9)
40- <50 [n=67]	182.8(171.5-194.1)	10(14.9)	18(26.9)	41.5(38.2-44.8)	14(20.9)	145.4(108.6-182.1)	7(10.4)	13(19.4)
50-63 [n=32]	187.4(158.9-215.8)	8(25.0)	5(15.6)	62.5(26.6-78.9)	9(28.1)	119.1(67.0-171.2)	3(9.4)	4(12.5)
Total	191.4(82.1-200.7)	40(20.2)	42(21.2)	51.8(42.2-59.0)	62(31.3)	169.8(142.3-197.8)	46(23.2)	45(22.7)

*HDL=high density lipoproteins; ^a Borderline cholesterol= ≥ 190 mg/dl, high= ≥ 240 mg/dl ^b Low HDL: < 50 mg/dl (for men) and < 40 mg/dl (for women). ^c Triglycerides: borderline= ≥ 150 mg/dl, high= ≥ 180 mg/dl

Table 4. Clustering of Non Communicable Diseases Risk Factors in Relation to Genders of the Studied King Faisal University' Employees

Risk factors #	P	S	O	F/V	HTN	Sg	Dys*	Distribution: No. (%)			P value*
								Women (n=198)	Men (n=493)	Total (n=691)	
7	+	+	+	+	+	+	+	--	19(3.9)	19(2.7)	--
6	+	+	+	+	+	-	+	--	6(1.2)	6(0.9)	--
6	+	+	+	+	-	+	+	--	6(1.2)	6(0.9)	--
6	+	-	+	+	+	+	+	10(5.1)	2(0.4)	12(1.7)	0.001
6	+	+	+	+	+	+	-	--	10(2.0)	12(1.7)	--
Total								10(5.1)	26(4.5)	36(5.2)	0.532
5	+	+	-	+	+	+	-	--	12(2.4)	12(1.7)	--
5	+	-	+	+	+	-	+	6(3.0)	12(2.4)	18(2.6)	0.417
5	-	-	+	+	+	+	+	5(2.5)	3(0.6)	8(1.2)	0.047
Total								11(5.6)	27(5.5)	38(5.5)	0.552
4	+	+	+	+	-	-	+	--	12(2.4)	12(1.7)	--
4	+	+	+	-	+	-	-	--	6(1.2)	6(0.9)	--
4	+	+	+	+	-	-	-	--	10(2.0)	10(1.4)	--
4	+	+	-	+	+	-	-	--	4(0.8)	4(0.6)	--
4	+	-	+	-	+	+	+	6(3.0)	13(2.6)	19(2.7)	0.477
4	+	-	+	+	-	+	-	5(2.5)	11(2.2)	16(2.3)	0.506
4	+	-	+	+	+	-	-	7(3.5)	11(2.2)	18(2.6)	0.236
4	+	-	+	+	-	-	+	8(4.0)	12(2.4)	20(2.9)	0.187
4	+	-	+	+	+	-	-	5(2.5)	6(1.2)	11(1.6)	0.023
4	-	+	+	+	-	-	+	--	6(1.2)	6(0.9)	--
4	-	-	+	+	+	+	-	4(2.0)	4(0.8)	8(1.2)	0.17
4	-	-	+	+	+	-	+	4(2.0)	2(0.4)	6(0.9)	0.06
Total								39(19.6)	97(19.7)	136(19.7)	0.538**
3	+	-	+	+	-	-	-	9(4.5)	57(11.6)	66(9.6)	0.002
3	+	-	-	+	-	-	+	4(2.0)	9(1.8)	13(1.9)	0.54
3	-	-	+	-	+	-	+	7(3.5)	--	7(1.0)	--
3	-	+	-	+	-	-	+	--	5(1.0)	5(0.7)	--
3	-	-	+	+	+	-	-	4(2.0)	11(2.2)	15(2.2)	0.559
3	-	-	+	+	-	+	-	8(4.0)	13(2.6)	21(3.0)	0.231
3	-	-	+	+	-	-	+	5(2.5)	37(7.5)	42(6.1)	0.007
Total								37(18.7)	132(26.8)	169(24.5)	0.014**

*Fisher Exact, **Chi square for independent samples. p= Physical inactivity of < 600 METS/minute/week, S= current daily smoking, O= obesity with BMI > 29.9 , F/V=low consumption of fruits and vegetables < 5 servings/day, HTN= hypertension $> 140/90$ mmHg, Sg=fasting blood sugar > 126 mg/dl, Dys*= the presence of dyslipidemia included cholesterol ≥ 240 mg/dl, triglycerides of ≥ 180 mg/dl and/or low high density lipoproteins < 50 mg/dl for men and < 40 mg/dl for women)

dl for men) was encountered in 38.9% with significant downward trend in relation to age ($p=0.012$), while among women low HDL (< 40 mg/dl) was encountered in 31.3%. Total subjects with low HDL accounted for 254(36.8%). Triglycerides (TG) was borderline high (≥ 150 mg/dl) in 149 (21.6%) and high (≥ 180 mg/dl) in 100 (14.5%). Elevated TG levels was detected in 32% of men and 46.0% of women ($p=0001$).

Clustering of NCDs risk factors

Figure 4 displays the distribution of risk factors in

relation to genders, 19 men (2.7% of total and 3.9% of men) had seven risk factors, 36 (5.2%), [26 men (4.5%) and 10 women (5.1%)] with 6 risk factors, 38 (5.5%), [27 men (5.5%) and 11 women (5.6%)] with 5, 136 (19.7%), [97 men and 39 women] with 4 factors and 169 (24.5%), [132 men and 37 women] with 3 (more in men 28.8% vs 18.7% in women), over all, 301 men (61.1%) and 97 women (49.0%) had ≥ 3 risk factors. Those with two risk factors constituted 240 (34.7%), [173 men (35.1%) and 67 women (33.8%)], 32 (4.6%) had one risk factor (3.4% men and 7.5% women). Only 21(3.0%) of the

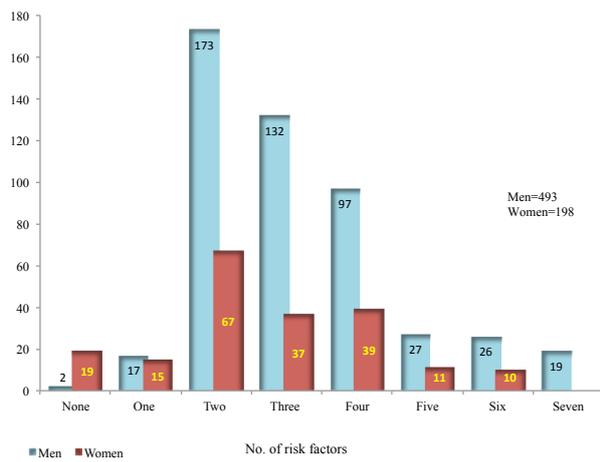


Figure 4. Number of Non-Communicable Diseases Risk Factors among King Faisal University Employees Distributed by Genders

Table 5. Univariate and multivariate analysis of correlates for clustering of the non communicable risk factors among employees at King Faisal University

Independent variables	Risk factors: No. (%)		Univariate analysis
	≥3 (N=398)	<3 (N=293)	Odds ratio (95%CI)
Age groups (years):			
< 30	42(10.6)	56(19.1)	Reference
30-<40	83(20.9)	111(37.9)	0.50(0.32-0.85)**
40-< 50	147(36.9)	89(30.4)	1.34(0.98-1.85)
50-63	126(31.6)	37(12.6)	3.21(2.14-4.80)**
Gender:			
Women	97(24.4)	101(34.5)	Reference
Men	301(75.6)	192(65.5)	1.63(1.17-2.28)**
Nationality:			
Non Arabs	18(4.6)	14(4.8)	Reference
Saudis	301(75.6)	230(78.5)	0.85(0.60-1.22)
Arab non Saudis	79(19.8)	49(16.7)	0.94(0.46-1.12)
Residence:			
Rural	57(14.3)	42(14.3)	Reference
Urban	341(85.7)	251(85.7)	1.00(0.65-1.54)
Educational status			
Primary/preparatory	56(14.1)	53(18.1)	Reference
Secondary	141(35.4)	69(23.5)	1.78(1.27-2.50)**
College or higher	201(50.5)	171(58.4)	0.73(0.54-0.98)*
Job within the University			
Faculty	136(34.2)	117(39.9)	Reference
Administrative	186(46.7)	127(43.3)	1.15(0.84-1.55)
Technicians and others	76(19.1)	49(16.7)	1.17(0.79-1.75)
Comorbidities:			
Hypertension	34(8.5)	15(5.1)	1.73(0.92-3.24)
Diabetes	34(8.5)	22(7.5)	1.15(0.66-2.01)
Smoking status:			
Never	279(70.1)	234(79.9)	Reference
Current smokers	97(24.4)	34(11.6)	2.45(1.61-3.75)**
Ex smokers	22(5.5)	25(8.5)	0.63(0.35-1.14)
Body mass index:			
Lean/desirable	56(14.1)	192(65.5)	Reference
Overweight	159(39.9)	71(24.2)	2.08(1.49-2.91)*
Obese	183(46.0)	30(10.2)	7.46(4.87-11.41)**
Physical activity levels:			
High	6(1.5)	20(6.9)	Reference
Moderate	49(12.3)	111(37.9)	1.96(1.35-2.86)*
Low	343(86.2)	162(55.3)	5.04(3.49-7.27)**

*CI= Confidence intervals. * p<0.05, ** p<0.001. Adjusted for other independent variables in the model. For the multivariate logistic regression model: percent predicted=76.1, constant=-1.293, Hosmer and Lameshow test: Chi-square=6.042, p=0.642. Risk factors included: obesity (body mass index <29.9), current daily smoking, insufficient vegetables and fruits servings (< 5 servings/day), physical inactivity (<150 minutes/week), hypertension (blood pressure >140/90mmHg), elevated blood sugar level (>126mg/dl), and dyslipidemia (triglycerides>180mg/dl and low high density lipoproteins)

sampled population had no risk factors (two men and 19 women). Table 4 demonstrates the clustering of risk factors (≥ 3) in relation to genders. Physical inactivity, smoking (in men), obesity and insufficient intake were predominant risk factors encountered along different categories of combinations. Those with combinations of ≥ 6 risk factors, behavioral risk factors namely physical inactivity, smoking (in men), obesity, insufficient intake of vegetables and fruits were consistently found among men, while women showed significant combination of the physical factors and dyslipidemia than men. Table 5 shows the results of univariate analysis and multivariate logistic regression model of the independent variables that potentially favor clustering of NCDs risk factors.

Multivariate logistic regression model showed that gender (men, adjusted Odds ratio 'aOR'=1.51, CI=1.11-2.14), aged ≥ 50 years (aOR=3.06, CI=1.99-4.72), with <college education (aOR=1.75, CI=1.20-2.47), current daily smokers (aOR=2.37, CI=1.58-3.58), obese (aOR=6.96, CI=4.55-10.63) and low PA level (aOR=4.59, CI=3.03-6.98) were the significant positive predictors for the clustering of risk factors. Residence, nature of job within the University's, nationality, and the presence of previously diagnosed chronic diseases (diabetes, HTN) had no influence on risk factors clustering among the studied sample.

Discussion

This cross-sectional study although not representative yet provided a detailed description of the prevalence of behavioral and biochemical NCDs risk factors. This study revealed that daily smokers accounted for 22.7%, with 94.9%, 95.1% and 86% consumed <5 servings per day of vegetables, fruits and both fruits and vegetables/day respectively, 73% were physically inactive, 64% were overweight or obese, 22.1% with HTN, 21.5% diabetics Elevated Cholesterol level was found in 36.6%, low high density lipoproteins in 36.8%, and elevated triglycerides in 36.1%.

Our results are comparable to those reported from a South African study where employees from 68 companies were included and it was found that 67% were physically inactive, 62% were either overweight or obese and 71% consumed <five servings of fruit and vegetables/day, 38% were smokers, one third had blood pressure >140/90mmHg, and 41% had cholesterol values more than 5.2 mmol/l and only 17% had fewer than 2 risk factors and the most prevalent number of risk factors was 3, which was found in 32% (Kolbe-Alexander et al., 2013). On the contrary, our study revealed that only 3% had no NCDs risk factors, while 398 (57.6%) had ≥ 3 NCDs risk factors. In a Brazilian study, the prevalence of smoking, excessive alcohol consumption and irregular fruits intake was higher in men, whereas a larger proportion of women exhibited leisure-time PinA, 26.1% of women and 18.9% of men displayed no risk factors, while 43% of men and 36.6% of women had two or more risk factors (de Costa et al., 2013), in the current study, except for smoking which was exclusive to men and overweight/obesity which showed

predominance among women, there was no differences in prevalence of other NCDs risk factors, moreover our results demonstrated a greater clustering of NCDs risk factors than the previous studies.

Also this study revealed as others (de Costa et al., 2013; Kolbe-Alexander et al., 2013) that the behavioral NCDs risk factors namely PinA, smoking, obesity and insufficient intake of vegetables and fruits were the predominant factors encountered. These environmental and behavioral risk factors made an important contribution to the global cancer burden (WHO, 2010). However, the magnitude of the effect of these risk factors on cancer control will depend on their prevalence and the direction of their time trends, both of which are on the rise in Saudi Arabia (W.H.O., 2012). These results suggested that employees are at increased risk for NCDs and they would benefit from worksite health promotion programs specially tackling modifiable risk factors.

The worksite has been shown to be a favorable setting to implement intervention programs aiming to reduce the risk for and prevalence of NCD's, as many individuals can be reached at the same time (Plotnikoff et al., 2005). These programs have been shown to play a role in improving health status and lifestyle behaviors, such as increased PA and reduced dietary fat intake among employees (Serxner et al., 2003). In this study 26.6% of were currently daily smokers and exclusively limited to men, which is consistent with findings reported previously using STEPS survey in 2005 (Saudi Arabia STEPS Report, 2005) where 24.7% of men were current smokers. However; unlike the current study, the percentage of women smokers was 1.4%, this difference may be attributed to the small sample of women included and different socio-demographic characters of participants especially relevant to health awareness.

The current study also revealed that only 5.1%, 4.9% and 14% of participants consumed ≥ 5 servings/day of vegetables, fruits and both fruits and vegetables/day respectively. A diet rich in vegetables and fruits has beneficial health effects including decrease in the likelihood of having a heart attack or stroke and possibly protect against some types of cancers (Wisemann, 2008). Globally, food habits have become poorer during the last three decades (F.A.O/W.H.O., 2006) and there has been a drastic change in food consumption patterns in the Arab Gulf countries. The structure of diet has shifted towards a high-energy-density with more fat, salt and added sugar, and with decline in the intake of fruit, vegetables, whole grains, and legumes (Musaiger et al., 2011). Saudi Arabia is one of six Arab countries where 79-96% of adults eat < 5 servings of fruit and vegetables/ day (W.H.O., 2010). Fruits consumption provides a protective effect against several types of cancer.

Examination of NCDs risk factor data of 89,404 Iranian individuals aged 15-64 years through an ecological study showed that breast cancer incidence had a significant positive relationship with the occurrence of diabetes mellitus, low fish consumption, and non-consumption of fruit, and academic educational status of the included women (Abbastabar et al., 2013). Although the results should be interpreted with caution, these findings and ours

are highlighting the likelihood of risk for breast cancer among employees of academic institutions. In addition, several studies have reported the positive relationship between breast cancer incidences and diabetes mellitus (Alegre, 2013; Kruk, 2013).

Another important NCDs risk factor is the PA, this study revealed that 73.1% of the participants were categorized as being of low PA, higher figures than those reported from community-based studies (Saudi Arabia STEPS Report, 2005; Al-Nozha et al 2007; Al-Hazaa 2007; Amin et al; 2011; Amin et al 2012) this difference could be explained partially by different age structure of the studied group and the sedentary nature of their jobs within the university. Research has shown that PA has a beneficial health effect and is essential means for prevention of many NCDs including cancers (Custs, 2011; Leitzmann, 2011). PinA is the most influential factor contributing to the high rates of obesity in Arab societies (Musaiger et al., 2012) and it was found that both PinA and greater BMI are modifiable risk factors for colon cancer in both Western and Asian populations (Morrison et al., 2013). In this study, 33.3% were overweight and 38.4% were obese. The prevalence of overweight and obesity in Arab countries has reached an alarming level, among adults ranging between 40- 60% for men and 50-70% for women (Musaiger et al., 2007). Rapid changes in dietary habits, lifestyle, and PinA have led to an increase in the prevalence of overweight and obesity in Arab countries with consequent increase in NCDs prevalence (Musaiger et al., 2012). In the current study, the number of overweight women was significantly higher than men while obesity had no significant difference in relation to genders. This finding is different from other study in the Gulf countries, where the prevalence of overweight was higher among men, while that of obesity was higher among women (Musaiger et al., 2012). In this study both previously diagnosed and newly discovered hypertensives constituted 22.2% and new hypertensive cases were detected in 6.1%. The rates of HTN and diabetes in the Gulf region including Saudi Arabia appear to be some of the highest in the world (Keaney et al., 2004) and more than one fourth of the adult Saudi population suffers from HTN (Al Nozha et al., 2007). A prevalence of 26% was reported out of the Saudi STEPS survey in 2005 with more women affection (Saudi Arabia STEP Report, 2005), yet a lower rate of HTN of 9.2% was reported by similar study conducted among King Khalid University personnel in Bisha (Ramadan et al., 2013). In the current study 11.6% were previously diagnosed as diabetics. Diabetes prevalence in Saudi Arabia was found to be $\approx 18\%$ (Saudi Arabia STEP Report, 2005). It is worth mentioning that during this survey, 6.1% and 9.9% were newly diagnosed cases of HTN and diabetes respectively without being previously aware of their conditions.

These findings highlight the necessity for screening programs for early case detection and as initial platform for health education initiatives for NCDs prevention. Dyslipidemia is an important risk factor for many NCDs (Al-Kaabba et al., 2012) and there is some evidence of its association is associated with some cancers (Jafri and Karas, 2010). In this study, high TG and total cholesterol

levels were detected in 32% and 36.6% respectively. Women had statistically significant higher levels of total cholesterol and TG than men. Low HDL was detected in 36.8% of participants. The results of the current study are in agreement with a previous study conducted in Saudi Arabia where the prevalence of dyslipidemia rate was in the range of 20-44% (Al-Kaabba et al., 2012), moreover, Saudi Arabia's STEP Report revealed that at least one fifth of the included population had high cholesterol level (Saudi Arabia STEP Report, 2005). Knowledge on the clustering pattern of NCDs risk factors may guide the design of more effective health promotion initiatives (de Costa et al., 2013).

This study provided a detailed description of the different NCDs combinations encountered among the surveyed employees. In their cross-sectional study, de Costa et al in 2013, found that 43% of men and 36.6% of women clustered at least two NCDs risk factors, three (19.2%) and five (9.8%). The results reported by the previous study are far less than we have found but this difference may be attributed to methodological considerations and the number and type (behavioral/biochemical) of the NCDs risk factors studied. Irrespective of the criteria adopted to classify PA level and an unhealthy diet, studies that evaluated simultaneous risk factors found that these two behaviors namely PA and unhealthy diet were the most prevalent (Schuit et al., 2002; Poortinga, 2007; Moura et al., 2009; de Costa et al., 2013; Kolbe-Alexander et al., 2013). Another significant clustering pattern in this study was smoking, which was present in many combinations in men contrary to what was found by de Costa and his coworkers in 2013 in Brazil where smoking was more in risk factors combinations among women (de Costa et al., 2013). Considering simultaneous clustering of NCDs risk factors, our findings were similar to other studies conducted in Brazil (de Costa et al., 2013), England (Poortinga, 2007), Denmark (Schuit et al., 2002) and South Africa (Kolbe-Alexander et al., 2013).

One interesting finding revealed from this study was the effect of low PA on clustering of risk factors, where those with low PA were >4 folds at risk for having ≥ 3 NCDs. Kolbe-Alexander and his coworkers found that employees with insufficient PA had a higher number of additional modifiable risk factors for NCD's than those who were meeting PA recommendations (Kolbe-Alexander et al., 2013). These results are supported by another cross-sectional study (Ekblom-Bak et al., 2010) where the odds for the physically active Swedish participants having ≥ 3 risk factors were 50% lower than those who were inactive, even after adjusting for confounders. Furthermore, in the same study, the odds of having additional risk factors, such as hypertension or overweight, were further reduced among the participants with higher levels of cardiovascular fitness (Ekblom-Bak et al., 2010). In our study, men were more likely to exhibit ≥ 3 NCDs risk factors than women. The same pattern was reported from other studies around the world (Schuit et al., 2002; Poortinga, 2007; Moura et al., 2009). Also, those aged >50 years were more at risk for NCDs risk factors clustering; this was in agreement with other studies indicated that advancing age is accompanied by

greater clustering of risk factors (Poortinga et al., 2007; de Costa et al., 2013). Moreover, some claimed that higher proportion of smokers and inactive individuals were found among the older subjects which may explain the excessive clustering at older age (Katano et al., 2010).

As in most studies investigated the associations between NCDs risk factors and educational status (Schuit et al 2002; Poortinga, 2007; Muniz et al., 2012; de Costa et al., 2013; Abbastabar et al., 2013) this study confirmed that individuals with < college education tend to cluster and accumulate more risk factors. Suitable means to delivery health education are needed to convey knowledge to the population about chronic diseases. Ministries of Health in many developing countries have introduced and implemented successful health education programs like family planning, immunization services and infection prevention, but those dedicated to NCDs are in the form of health promotion are frequently short term and non sustainable and proved non-effective, health promotion targeting those at middle age should follow new strategies with involvement of all sectors including universities in order for effective and sustainable outcomes.

The results of this study can be viewed within the context of the following limitations: First, the response rate in our study was low (33.0%). Non-response may be due to the low level of health awareness (or consciousness about one's own health) among university employees. Study participants were either more health conscious, had a suspicion about their wellbeing, or both. Second, in the light of the previous notion, the results of this study may imply over estimation due to inclusion of high risk population during the recruitment phase (those with more risks). Although invitation to participate was forwarded to all employees within the university, the participation was voluntary and those participated are expected to be more health conscious or already have information about their health condition and participated for reassurance. Third, the social desirability would cast shadows on several items including servings of vegetables, fruits, smoking and PA patterns which may result in over/under estimation of these variables. On the other hand, the conservative nature of the Saudi society may hinder other behavioral risk factors namely alcohol intake and smoking (especially among women). Finally, the prevalence and clustering of NCDs risk factors are expected to be higher than the general population since the included university's employees were relatively older with more vulnerability to sedentary behavior.

In conclusion, over fifty percent of the studied university's employees had multiple (≥ 3) NCDs risk factors. Screening and health promotion initiatives should be launched at least targeting the modifiable NCDs risk factors to avert the excessive risk for cardiovascular disease, diabetes mellitus and several types of cancers.

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