

Research Article

Findings of Community Based Screening in the Kingdom of Saudi Arabia, 2014

Al Slail FY^{1*}, Al Saeedi MY², Afridi HU³, Al Omari SA⁴ and Kheir OO¹

¹National Diabetes and Prevention Program, Ministry of Health, Saudi Arabia

²General Non-communicable Diseases, Ministry of Health, Saudi Arabia

³Public Health Specialist, WHO, Libya

⁴Obesity prevention and control program, Ministry of Health, Saudi Arabia

*Corresponding author: Fatima Al-Slail, Director of the National Diabetes Prevention and Control Program, Ministry of Health, Riyadh, Saudi Arabia

Received: July 18, 2016; Accepted: August 08, 2016;

Published: August 11, 2016

Abstract

Introduction: Community based screening and awareness especially for non-communicable diseases is regularly done in annual festivals in KSA. The Directorate for Non Communicable Diseases participates in all the government sponsored community gatherings including annual festivals. However, the findings of screenings are not existent.

Methodology: A cross sectional study was conducted to assess the common non-communicable diseases and its associated risk factors. Festival visitors were invited and trained investigators conducted screening and filled the questionnaire after obtaining the written informed consent. Screening was done to assess diabetes, hypertension and osteoporosis. The questionnaire includes questions on socio-demographic characteristics, diet, physical activity, and self-reported history of chronic diseases.

Results: Among 830 visitors who opted for screening, the frequency of diabetes was 12.7 %, border line hypertension 18%, hypertension 37.7%, osteopenia 16.9% and osteoporosis 1.2 %. Age, BMI and having history of diabetes were independently associated with Diabetes.

Conclusion: Community based screening can become more organized and effective in kingdom of Saudi Arabia by following the recommendations of American Association of Diabetes Educators.

Keywords: Cross-sectional; Diabetes; Hypertension; Osteoporosis; Non-communicable; Screening

Introduction

The prevalence of Non-Communicable Diseases (NCD's) including diabetes type II, and its associated risk factors is increasing at alarming rate in Kingdom of Saudi Arabia (K.S.A) [1]. Global comparative prevalence data of 2013 ranked Saudi Arabia as seventh highest diabetes type II prevalent country in the world (24%) and is estimated to be sixth highest prevalent country (24.51%) in 2035 [2]. The most recent community based national NCD survey by Ministry of Health (MOH) reports that the total prevalence of diabetes (age 15 and above) was 13.4% in 2013. [3].

Ministry of Health, KSA while realizing the emerging problem, established Diabetes Control and Prevention Program (DCPP) at Non Communicable Disease Directorate in 2005. Presently the Program is endeavoring to implement the National Executive Plan of Diabetes Control 2010-2015, adopted from the Gulf Plan, prepared in collaboration with World Health Organization. An electronic diabetes registry was established in 2009, registering the diabetes type II patients from all the PHCC's of the 20 administrative regions of the kingdom. Till date (5th January 2015) only 345213 type II patients are registered which are far below the target. Efforts are underway to strengthen screening activities at community and primary health facility level.

Community Based Screenings (CBS) are rampant because it includes the honoring of community organizations' requests and efforts to improve health, particularly among populations with

barriers to care such as lack of access, trust, and convenience. These screening events can help educate community members about diabetes-related concepts and serve as a bridge to appropriate clinical care [4]. Studies also recommend earlier diagnosis and intervention to minimize the progression of diabetes and the development of associated complications [5,6]. Many individuals throughout the KSA have been screened at malls and festivals with objectives to raise awareness and screen the undiagnosed people. However very limited studies are available on the findings of the community based screening. Every year, Janadriyah Festival takes place in KSA. It is one of the biggest cultural and heritage festival organized by the National Guards. The NCD Directorate participates in the festival every year and this time conducted a study. The findings of this study aim to inform the scientific community about the frequency of common NCD's and its associated factors among the visitors of Janadriyah Festival visitors in Riyadh, Saudi Arabia. It will also help the researchers to find unified way of screening and reporting.

Methodology

A cross sectional study was conducted in 2014 among Jandariyah festival visitors to assess the common non-communicable diseases and its associated risk factors. Study was approved by the IRB, Ministry of Health. The visitors were informed and invited for screening through announcements and posters display at the entry gates and other important sites of the festival area. The team of NCD Directorate present in Janadriyah was having a separate area of screening for male

and female visitors. After obtaining the written informed consent, a pre tested questionnaire was filled by the interviewers which include questions on socio-demographic characteristics, diet, physical activity, and self-reported history of NCDS.

Weight, height, and blood pressure were measured by a trained professional. Omron HN286 (SN: 201207-03163F) and Omron M6 Comfort (HEM-7223-E) instruments were used to measure weight and blood pressure respectively. Random Blood Sugar was measured through Abbott Diabetes Care Optium Xceed glucometer. Subject bone mass was assessed by calcaneal Quantitative Ultrasound by Hologic Sahara. Visitors were classified based on T-scores according to WHO criteria into three categories (X). 1. Normal (T-score 1 and above), 2. Osteopenia (T-score 1 to 2.5) and 3. Osteoporosis (T-score 2.5 and below) [7].

We measured weight and height to calculate Body Mass Index (BMI) as weight (kg)/height (m²). For descriptive purposes, participants were classified into three groups: 1) normal weight, BMI between 18.5 and 24.9; 2) Overweight, BMI between 25.0 and 29.9; 3) Obese class, BMI equal/greater than 30 and above) [8]. The BP was classified as having 1. Normal, SBP, less than 120 and DBP less than 80. 2). Borderline hypertension as SBP, between 120 and less than 140, and DBP between 80 and less than 90. Hypertension is reported as having SBP equal/greater than SBP, 140 and DBP 90 [9]. Those who measured equal/more than 200 mg/dl were reported as diabetic. The statistics of daily fruits and vegetables consumption per day was reported as written in the questionnaire. 1). No consumption on daily basis, 2). 2-4 servings per day and 3). Five times or more servings per day. Similarly the physical activity was reported as not practicing, less than 60 min/week and 150 min or more per week. The history of chronic infections and family history of chronic infections were asked by having the responses as Diabetes, Hypertension, Asthma, Cholesterol, Cancer and Others.

Statistical analysis

The socio demographic characteristic, lifestyle characteristics, history of chronic illness and family history of chronic illness of respondents were analyzed according to gender. History of chronic illness was analyzed as multi response variable. We used a univariate analysis to assess the association between diabetes and its associated factors. To control for confounding and interactions, a backward elimination multivariate logistic regression model was used to measure association between outcome variables and other co-morbid. Variables were removed one by one based on the significance level of their effect on the model, starting with the variable with the highest $p > 0.5$, till all variables kept had a $p \leq 0.5$ in the analysis of effect.

Results

A total of 830 festival visitors visited the screening facility of NCD, MOH and filled the questionnaire. The mean age of the participants was 44 with SD of 9.55. The lowest age was 12 years being a female and highest was 81 years being a male. Majority of the males (35.3%) were between 30 and less than 40 years of age, while in female age 40 and less than 50 of years of age were in majority (36.1%). The visitors were predominantly married (89%), Saudis (95.1%) followed by Egyptians (1.2%). Among the visitors there were housewives (31.8%),

Table 1: Socio-demographic characteristics of Janadriyah festival visitors.

Characteristics	Male 387 n(%)	Female 443 n(%)	Total 830 n(%)
Age(Yr.)			
10-Less than 20	000(00.0)	004(00.9)	004(00.5)
20-Less than 30	015(04.1)	001(00.2)	016(02.0)
30-Less than 40	129(35.3)	126(29.2)	255(32.0)
40-Less than 50	116(31.8)	156(36.1)	272(34.2)
50-Less than 60	076(20.8)	114(26.4)	190(23.8)
60 & above	029(07.9)	031(07.2)	060(07.5)
Total	365	432	797
Marital status			
Single	20(05.2)	024(05.4)	044(05.3)
Married	367(94.8)	372(84.0)	739(89.0)
Divorce	000(00.0)	020(04.5)	020(02.4)
Widow/Widower	000(00.0)	027(06.1)	027(03.3)
Total	387	443	830
Job/ Occupation			
Housewives	000(00.0)	263(59.5)	263(31.8)
Civil Servant	185(47.9)	100(22.6)	285(34.4)
Free Lancer	021(05.4)	003(00.7)	024(02.9)
Military	72(18.7)	00(00.0)	72(08.7)
Private Sector	49(12.7)	17(03.8)	66(08.0)
Retired	53(13.7)	10(02.3)	63(07.6)
Student	02(00.5)	04(00.9)	06(00.7)
Don't work	004(01.0)	045(10.2)	049(05.9)
Total	386	442	828
Nationality			
Saudi	349(90.2)	440(99.3)	789(95.1)
Bengali	01(0.3)	00(00.0)	001(00.1)
British	01(0.3)	00(00.0)	001(00.1)
Egyptian	08(2.1)	02(00.5)	010(01.2)
Jordanian	07(1.8)	00(00.0)	007(00.9)
Kuwaiti	01(0.3)	00(00.0)	001(00.1)
Pakistani	02(0.5)	00(00.0)	002(00.2)
Palestinian	02(0.5)	00(00.0)	002(00.2)
Sudanese	05(1.3)	00(00.0)	05(0.6)
Syrian	4(1.0)	1(0.2)	05(0.6)
Yemini	7(1.8)	0(0.0)	07(0.9)
Total	387	443	830

civil servants (34.4%) and having military background (8.7%) (Table 1).

Rice is the predominantly daily food consumed (49.2%) among Janadriyah festival visitors followed by bread (41.2%) and fast food (8.3%). Tea/Coffee is the predominant drink consumed on daily basis (46.1%) followed by milk/yogurt (27.6%) and fresh juices (11.1%). Fruit was not consumed on daily basis by 41.1% of the respondents and 55.5% of the visitors reported not doing any moderate or severe physical activity. The frequency of smoking was 12.2% among visitors (Table 2).

Among the respondents 18.4% reported to have history of type II diabetes, followed by high blood pressure (16.4%) and high cholesterol (11.3%). Among respondents, the family history having diabetes was 32.9% followed by high blood pressure (27%) (Table 3).

Among the visitors, 10.5% have normal body weight (18.5-24.9 kg/m²), 32% were overweight (25-29.9 kg/m²) and 57.5% were obese class (≥ 30 -34.99 kg/m²). Border line hypertension and hypertension was 18% and 37.7% respectively among Janadriyah festival visitors attending screening program. Diabetes was present in 12.7% of the respondents, more in females (14.6%) as compared to males (10.6%). Osteopenia was reported in 16.9% of the visitors while osteoporosis was reported in 1.2% of the visitors (Figure 1).

Age, history of chronic illness, physical activity, high BP and

Table 2: Life style characteristics of Janadriyah festival visitors in Riyadh, KSA.

Characteristics	Male 387 n(%)	Female 443 n(%)	Total 830 n(%)
Daily Food Consumption	Responses	Responses	Responses
Bread	23(35.7)	264(47.8)	495(41.2)
Hot Drink	01(0.2)	01(0.2)	2(0.2)
Rice	339(52.4)	251(45.5)	590(49.2)
Eggs	00(0.0)	01(0.2)	02(0.1)
Fast Food	74(11.4)	25(04.5)	99(8.3)
Salad/Fruit	01(0.2)	05(0.9)	06(0.5)
Meat	01(0.2)	00(0.0)	01(0.1)
Pasta	00(0.0)	01(0.2)	01(0.1)
Sweets	00(0.0)	04(0.7)	04(0.3)
Total	647	552	1199
Daily Drink Consumption	Responses	Responses	Responses
Tea/Coffee	326(44.2)	360(48.0)	686(46.1)
Milk/Yougurt	208(28.2)	202(26.9)	410(27.6)
Soft Drink	059(08.0)	66(08.8)	125(8.4)
Energy Drink	04(0.5)	02(00.3)	06(0.4)
Fresh Juices	109(14.8)	56(7.5)	165(11.1)
Energy Drinks	07(00.9)	00(0.0)	07(0.5)
Juices Sweetened	22(03.0)	63(8.4)	85(5.7)
Ginger	01(0.1)	01(0.1)	02(0.1)
All	01(0.1)	0(0.0)	1(0.1)
Total	737	750	1487
Daily Fruit Consumption			
2-4 times	178(46.0)	226(51.1)	404(48.7)
5 times or more	040(10.3)	044(10.0)	84(10.1)
No consumption	169(43.7)	172(38.9)	341(41.1)
Total	387	442	829
Physical Activity			
Not practicing	176(45.5)	284(64.1)	460(55.5)
Less than 60 min/week	166(42.9)	124(28.0)	290(34.9)
150 min or more/week	045(11.6)	035(07.9)	080(09.6)
Total	387	443	830
Smoking Status			
No	295(76.2)	434(98.0)	729(87.8)
Yes	092(23.8)	09(02.0)	101(12.2)
Total	387	443	830

obesity were associated with diabetes. However during logistic regression only age, BMI and having history of chronic diseases were significant variables. The risk of being diabetic was more in obese patients (adjusted odds ratio [AOR] =1.80; 95% confidence interval [CI]: [1.05-3.10] and increased with age (AOR=1.03; 95% CI: 1.00-1.06). Respondents reporting having chronic disease other than diabetes were 1.22 times more likely to have diabetes, while those having history of diabetes along with other chronic disease were 20.3 times more likely to have diabetes (AOR=20.31; 95% CI: 9.89-41.67) (Table 4).

Discussion

The annual cultural and heritage festivals like Janadriyah in KSA provides good opportunity for the community based screening. Traditionally every governmental sector participates in these events including NCD Directorate of the MOH. The annual cultural and heritage festival is preferred by local population as who avail the opportunity of screening, majority (95.1 %) were Saudis, dominated by housewives (31.8%). Diabetes type 2 was 12.7% based on random blood test done through glucometer and 18.4 % reported to have history of diabetes. Limited studies for comparison are available on the findings of community based screenings especially during festivals. Our findings are close to that of a nationally representative sample of Saudis aged 15 years or older, reporting 13.4 %prevalence of diabetes [3]. In 1980s the prevalence of diabetes was 4.7 % in rural Saudi Arabia among aged 15 years or older [10] while in 1995 to

Table 3: History of chronic illness among Janadriyah festival visitors.

Characteristics	Male 387 n(%)	Female 443 n(%)	Total 830 n(%)
History of Chronic Illness	Responses	Responses	Responses
Asthma	14(03.2)	50(8.2)	64(6.1)
Diabetes Mellitus (Type 2)	78(17.7)	115(18.9)	193(18.4)
Osteoporosis	02(0.5)	07(1.1)	9(0.9)
Heart Disease	1(0.2)	6(1.0)	7(0.7)
Thyroid	2(0.5)	10(1.6)	12(1.1)
Cancer	0(0.0)	5(0.8)	5(0.5)
Cholesterol	38(8.6)	81(13.3)	119(11.3)
High BP	54(12.3)	118(19.3)	172(16.4)
Spastic Colon	2(0.5)	2(0.3)	4(0.4)
Rheumatism	0(0.0)	3(0.5)	3(0.3)
Other	3(0.7)	3(0.5)	6(0.6)
Not known	246(55.9)	210(34.4)	456(43.3)
Total	440	610	1050
Family History of Chronic Illness	Responses	Responses	Responses
Asthma	11(02.1)	043(4.5)	54(03.6)
Diabetes Mellitus (Type 2)	192(36.4)	298(31.0)	490(32.9)
Osteoporosis	9(1.7)	69(7.2)	78(05.2)
Heart Disease	11(2.1)	64(6.7)	75(05.0)
Thyroid	00(0.0)	1(0.1)	1(0.1)
Cancer	2(0.4)	29(3.0)	31(2.1)
Cholesterol	21(4.0)	116(12.1)	137(9.2)
High BP	132(25.0)	270(28.1)	402(27.0)
Spastic Colon	000(00.0)	1(0.1)	1(0.1)
Rheumatism	1(0.2)	1(0.1)	2(0.1)
Other	1(0.2)	4(0.4)	5(0.3)
Not known	148(28.0)	64(6.7)	212(14.4)
Total	528	960	1488

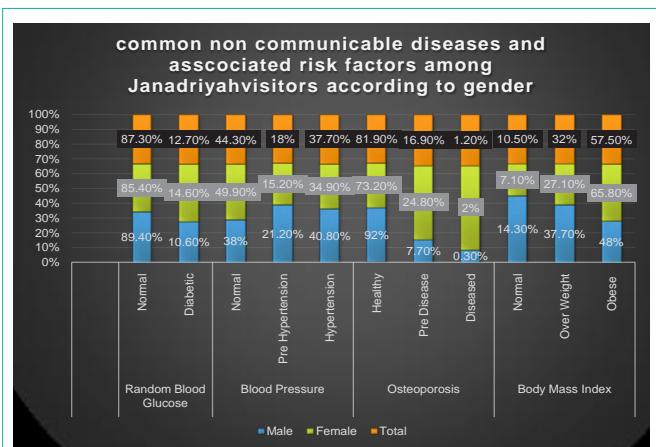


Figure 1: Common Non Communicable diseases and associated risk factors among Janadriyah visitors according to gender.

2000 , the prevalence of type 2 diabetes was reported 23.7% among individuals 30 to 70 years old [11]. Community based study in 2005 reported 15.3% prevalence of diagnosed diabetes and 18.3% prevalence of measured diabetes among Saudis aged 15 to 64 years [12].

Border line hypertension among Janadriyah festival visitors was 18% while in community based Saudi survey was 40.6 %. The frequency of hypertension was 37.7% as compared to Saudi community based survey of 15.2% [13]. The significant high frequency of hypertension in our study might be that our findings were based on single reading. Secondly the recommended advice of taking rest for 15 minutes might have been overlooked by participants due to overcrowding at the festival.

Table 4: Association between diabetes and its associated risk factors among Janadriyah Festival visitors, Riyadh.

Variables	Crude Odds Ratio (95 % C.I)	Adjusted Odds Ratio (95% C.I)
Age	1.08 (1.05-1.10)	1.03(1.00-1.06)
Gender		
Male	1 (Ref)	
Female	1.44 (0.95-2.19)	
Body Mass Index		
Not obese	1 (Ref)	1 (Ref)
Obese	1.90 (1.21-2.9)	1.80 (1.05-3.10)
Blood Pressure		
Normal	1 (Ref)	
Hypertension	1.76 (1.16-2.66)	
Family history of diabetes		
No	1 (Ref)	
Other chronic diseases	1.02 (.50-2.08)	
Diabetes	1.43 (.86-2.38)	
Presently have chronic disease		
No	1 (Ref)	1 (Ref)
Other chronic diseases	1.33 (.45-3.89)	1.22 (.41-3.68)
Diabetes	29.72 (15.16-56.49)	20.31 (9.89-41.67)
Physical Activity		
150 min or more/week	1 (Ref)	
Not practicing/ Less than 60 min/week	2.98 (1.06-8.32)	

The frequency of osteopenia was 16.9% while that of osteoporosis was 1.2% among the participants. Calcaneal quantitative ultrasound did not detect any osteopenia or osteoporosis cases in age group less than 30 years of age. Majority (26.8%) of the osteopenia cases were detected in age group 50 to less than 60 and similar cases were detected in 60 years and above group. On the other hand, the frequency of osteoporosis was 1.6% and 5% in age group 50 and less than 60, and age group 60 and above respectively. National estimates on osteoporosis and osteopenia are not available, however in a study of 830 postmenopausal Saudi women 50-80 years of age, the rate of osteopenia and osteoporosis was 30.6 % and 39.5 % respectively [14]. In a study of 321 healthy Saudi women, the prevalence of osteoporosis was 3.2, 5.9, and 19 % for age groups 31- 40 years, 41- 50 years, and > 50 years respectively. The prevalence of osteopenia in the respective age groups was 38, 38, and 66% [15]. The low prevalence of osteopenia and osteoporosis in our study might be that our study also include males, comparatively healthy and mobilized people might have visited the festival and been recruited.

Self-reported history of having diabetes mellitus type 2 was most frequent (18.4%) followed by high BP (16.4%) and osteoporosis in (0.9 %) of the visitors. The family history of having chronic illness was also having the same trend as DM type 2 was pre dominant (32.9%) followed by high BP (27%) and osteoporosis (5.2%). All of the above findings show that diabetes, elevated BP and osteoporosis are the burdensome disease in KSA. Our results call for an organized integrated NCD screening and surveillance strategy in the Kingdom and CBS should be given importance in the strategy.

The adoption of western lifestyle in in many developing countries, characterized by decreased physical activity and high caloric intake is contributing to alarming epidemiological shift in the leading causes of death from communicable to non-communicable diseases [16,17]. The Burden of Disease study 2010 indicates that elevated BMI is the leading risk factor for disability-adjusted life years in the KSA [18]. The frequency of obesity was 57.5 % among Janadriyah festival visitors while national survey reports the prevalence of 33.5% [19]. Obesity was more in females in present study (65.8 % female vs 48% male)

as well as in community based survey (33.5% female vs 24.1% male) [19]. The reason of high frequency of obesity in our study may be due to preponderance of housewives (31.8%) in our study. Obesity was independently associated with diabetes in community based study [19] as well as in present study [AOR]=1.73; 95% CI]: 1.01-2.97].

Study in KSA shows that obesity was associated with physical activity and unhealthy eating habits [19]. In our study, among daily consumption of diet, rice is frequently consumed (49.2%) followed by bread (41.2%). Fast food is consumed on daily basis by 8.3% of the visitors. The most frequent daily consumed drink is tea/coffee (46.1%) followed by milk/yogurt (27.6%). A total of 41.1 % do not consume fruit on daily basis and 10.1% consume 5 servings or more on daily basis.

A survey was conducted among 960 female students at King Faisal University in AL-Hasa, Saudi Arabia. 22% of the students consumed at least five servings of fruit and/ or vegetables per day, majority of them are in the normal BMI category [20].

Physical activity reduces the likelihood of obesity [21]. Unfortunately more than half of population (55.5%) among the festival visitors reported of not doing physical activity on daily basis while only 09.6% reported to do physical activity of 150 min or more / week. Community based NCD study shows that 46% of men and 75% of the women practiced low to no physical activity at all [19].

Our study has some limitations. First, our data are from a cross-sectional study in festival environment and might be having a self-selection bias. Second, data on physical activity and diet are self-reported and subject to recall. As it was the first attempt of CBS in busy environment, therefore instead of using validated questions, only few questions were asked to assess physical activity and diet. We recommend that these findings be interpreted carefully during comparison with different studies.

Our findings call for increased awareness of non-communicable diseases including diabetes in the Kingdom. Innovative culturally appropriate strategies should be developed and implemented to improve healthy dietary habits and increase physical activity. Lot

of community based activities like festivals and health fairs are celebrated in KSA. The Ministry presence in such activities should benefit the nation in enhancing the awareness and early detection of NCD's and its risk factors. We call upon all the stakeholders working for the cause of diabetes in KSA to make community based screening more organized and systematic by following the below mentioned recommendations of the American Association of Diabetes Educator [22].

- Target CBS for those at higher risk
- Begin with a non-invasive risk assessment
- Explain the meaning of test results to participants.
- Insure adequate follow-up testing and diagnosis
- Form partnerships with providers of follow-up and emergency care in advance
- Limit blood glucose testing to qualified providers.
- Observe essential safety practices
- Restrict the use of finger stick and measurement devices to those intended for assisted monitoring of blood glucose (AMBG).
- Use recommended measures for blood glucose assessment

Conclusion

Community based screening can become an effective strategy for awareness and early detection of non-communicable diseases and its risk factors if it is carefully planned and implemented according to the scientific recommendations.

References

1. Institute for Health Metrics and Evaluation (IHME), "GBD arrow Diagram, Saudi Arabia. Risks of deaths.199-2010," IHME, University of Washington, Seattle, Wash, USA.
2. International Diabetes Federation. IDF Diabetes Atlas. Sixth Edition. 2015.
3. El Bcheraoui C, Basulaiman M, Tuffaha M, Daoud F, Robinson M, Jaber S, et al. Status of the diabetes epidemic in the Kingdom of Saudi Arabia, 2013. *Int J Public Health*. 2014; 59: 1011-1021.
4. West B, Parikh P, Arniella G, Horowitz CR. Observations and recommendations for community-based diabetes screenings. *The Diabetes Educator*. 2010; 36: 887-893.
5. American Diabetes Association. Standards of medical care in diabetes-2014. *Diabetes Care*. 2014; 37: 14-80.
6. Haas L, Maryniuk M, Beck J, Cox CE, Duker P, Edwards L, et al. National standards for diabetes self-management education and support. *Diabetes Care*. 2014; 37: 144-153.
7. WHO Scientific Group on the Assessment of Osteoporosis at Primary Health Care Level. Summary Meeting Report. Geneva, Switzerland: World Health Organization. 2004.
8. World Health Organization. Global Database on Body Mass Index: BMI Classification. 2009.
9. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL, et al. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. *Hypertension*. 2003; 42: 1206-1252.
10. Fatani HH, Mira SA, El-Zubier AG. Prevalence of Diabetes Mellitus in Rural Saudi Arabia. *Diabetes Care*. 1987; 10: 180-183.
11. Al-Nozha MM, Al-Maatouq MA, Al-Mazrou YY, Al-Harthi SS, Arafah MR, Khalil MZ, et al. Diabetes Mellitus in Saudi Arabia. *Saudi Med J*. 2004; 25:1603-1610.
12. Ministry of Health, Kingdom of Saudi Arabia, in collaboration with WHO. EMRO. WHO STEP wise Approach to NCD Surveillance. Country-Specific standard report Saudi Arabia. 2005.
13. El Bcheraoui C, Memish ZA, Tuffaha M, Daoud F, Robinson M, Jaber S, et al. Hypertension and Its Associated Risk Factors in the Kingdom of Saudi Arabia, 2013: A National Survey. *Int Journal of Hypertens*. 2014; 564679.
14. El-Desouki MI. Osteoporosis in postmenopausal Saudi women using dual x-ray bone densitometry. *Saudi Med J*. 2003; 24: 953-956.
15. Ghannam NN, Hammami MM, Bakheet SM, Khan BA. Bone mineral density of the spine and femur in healthy Saudi females: relation to vitamin D status, pregnancy and lactation. *Calcif Tissue Int*.1999; 65: 23-28.
16. Boutayeb A, Boutayeb S. The burden of non-communicable diseases in developing countries. *Int J Equity Health*. 2005; 14; 4: 2.
17. Amuna P, Zotor FB. Epidemiological and nutrition transition in developing countries: impact on human and health development. *Proc Nutr Soc*. 2008; 67: 82-90.
18. Ziad A Memish, Sara Jaber, Ali H Mokdad, Mohammad A AIMazroa, Murray CJ, Al Rabeeah AA. Burden of Diseases, Injuries and Risk Factors in the Kingdom of Saudi Arabia 1990-2010. *Prev Chronic Dis*. 2014; 11: 140176.
19. Memish ZA, El Bcheraoui C, Tuffaha M, Robinson M, Daoud F, Jaber S, et al. Obesity and Associated Risk Factors---Kingdom of Saudi Arabia, 2013: *Prev Chronic Dis* 2014; 11: 140236.
20. Al-Otaibi HH. The pattern of fruit and vegetable consumption among Saudi university students. *Glob J Health Sci*. 2013; 6: 155-162.
21. Camoes M, Oliveira A, Lopes C. The role of physical activity and diet on overall and central obesity incidence. *J Phys Act Health*. 2011; 8: 811-819.
22. American Association of Diabetes Educators. Recommendations for Community-Based Screenings for Prediabetes and Diabetes. AADE White paper. 2014.