Original Research Article

Predictors of hypertension in Oman

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ABSTRACT

Background: According to the Oman World Health Survey in 2008, the prevalence of hypertension in Oman is about 40%. Hypertension is associated with old people, male gender, smoker and impaired glucose tolerance. The objective of the study was to find out the important predictors of hypertension in Oman.
Methods: A cross sectional study in Omani adults more than 18 years of age was conducted. Blood pressure was measured and participants were classified as having hypertension. Height and weight was measured and body mass index was used to classify obesity by WHO guidelines. Multiple logistic regression was used to find the predictors of hypertension.
Results: Increase in age and body mass index were found to be important covariates of hypertension. People in the age group of 30 to 50 years were at high risk of hypertension (OR 1.6, p<0.05); likelihood increased to three times in more than 50 years age group (p<0.01) in univariate analysis. Overweight had almost 2 times (p<0.05) and obese had five times (p<0.01) more likelihood of hypertension than normal weight people. People with less education had more likelihood of hypertension. Smokers (OR 2.9, p<0.01) and males (OR 1.5, p<0.05) were at a higher risk of hypertension than non-smokers and females in multivariate analysis. Percentage accuracy of classification was 67.4%.
Conclusions: Age more than 50 years, male gender, BMI more than 30 and smoking were important predictors of hypertension in the study population.

Keywords: Hypertension, Predictors, Obesity, Smoking, Overweight

INTRODUCTION

Hypertension is a major public health global burden in many countries experiencing epidemiological transition.[1] It is estimated that the worldwide prevalence of hypertension could increase from 26.4% in 2000 to 29.2% in 2025.[2] Non communicable diseases constituted 58% of outpatient morbidity and 38% of inpatient morbidity in Ministry of Health institutions in Oman in 2007 that have increased from 42.5% and 37.4% in 1996, respectively. The WHO report in 2010 on country profiles estimated that non communicable diseases account for nearly 83% of the total deaths in Oman.[3] The increase in the burden from cardiovascular diseases is

also linked to the increase in the prevalence of chronic diseases such as diabetes and hypertension. The prevalence of hypertension has increased from 27% in 1995 to 32% in 2000. According to the Oman World Health Survey in 2008, the prevalence of hypertension in Oman is about 40%.[4] According to National Health Survey in Oman in 2000, it was found that hypertension was associated with old people (>60 years), male gender, smoker, impaired glucose tolerance. The percentage of hypertension was above the global average of between 25 and 30 percentage. WHO experts have warned that this number is likely to double to 50-60% by the year 2025.[5] Overweight and obesity among adults in Oman are present in 30% and 20% population respectively.

Although obesity is known to increase the risk of hypertension, few studies have evaluated body mass index across various ranges as a primary risk factor.[6] Both obesity and hypertension are important risk factors for cardiovascular diseases. Obesity is generally assessed using body mass index (BMI) which gives information on the distribution of weight with respect to height. Evidence gathered from several studies shows that central obesity is a greater risk factor for cardiovascular diseases.[7] Screening for non-communicable diseases is one of the top priorities of the Ministry of Health in Oman. Thus to early detect and treat disease cases and to prevent or delay occurrence of hypertension it is important to know the in depth role of vital predictors of hypertension which can be used to accurately screen the population to curb the epidemic of hypertension. With this background, the present study was done with the objective of finding the important predictors of hypertension in Oman.

METHODS

Data collection

A cross-sectional study was carried out in Rustaq polyclinic, Oman from February 2014 to June 2014. The study participants comprised of Omani adults attending the polyclinic as visitors accompanying the patients. Inclusion criteria were adults of Omani nationality, age more than 18 years and those who gave consent. The visitors less than 18 years of age and those who did not give consent were excluded from the study. Approval was taken from the research and ethics committee of Ministry of Health. A total of 500 adults were interviewed, using a predesigned and pretested questionnaire. The questionnaire aimed to collect information on socio-demographic variables of the participants. Height and weight was measured with a Detecto height and weight scale. The participants were looking straight ahead during measurement. The height of each participant was measured to the nearest 0.1 cm. Weight was measured in kilograms to the nearest 0.1 kg. BMI was calculated by dividing weight in kilograms by height in meters squared. Using the WHO classification, participants were classified in four categories of BMI (kg/m^2); underweight <18.5, normal 18.5–24.9, overweight 25.0–29.9 and obese ≥30.[8]

Blood pressure was measured using mercury sphygmomanometer. Brachial artery blood pressure was measured 3 times consecutively on seated participants with a rest of 5 minutes in between using a standardized mercury sphygmomanometer. The mean of the last two of these measurements was used for estimation of blood pressure.[9] Based on the definition of hypertension by the Seventh Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure guidelines (Chobanian et al 2003); participants with systolic blood pressure (SBP) of ≥140 mmHg and/or diastolic blood pressure (DBP) ≥90 mmHg or who reported to be on new antihypertensive medications were classified as hypertensive.[10] Prehypertension was defined

as SBP of 120–139 mmHg and/or a DBP of 80–89 mmHg. Grade 1 hypertension was defined as SBP of 140–159 mmHg and/or a DBP of 90–99 mmHg and Grade 2 hypertension was defined as SBP of 160–179 mmHg and/or a DBP of 100–109 mmHg.[11]

Statistical analysis

SPSS was used for data analysis. Chi square test was used for the initial hypothesis testing to identify the different determinants of hypertension. Univariate logistic regression was used to test the effects of independent variables on hypertension. Statistical significance of individual regression coefficients was tested using Wald's chi square statistic. A p value less than 0.05 was considered statistically significant. Odds ratio was calculated for all independent predictor variables. Significant covariates were entered in the multivariate logistic regression model which was performed using backward likelihood ratio method to predict hypertension. The model was considered final when it demonstrated an improvement over the intercept only model. An improvement over the baseline model was examined by likelihood ratio and Wald' statistic. The validity of the predicted probabilities was assessed through the classification table; wherein the percentage accuracy of classification gave the overall percentage of cases that were correctly predicted by the model. Hosmer and Lemeshow test was used to assess the fit of logistic model against the actual outcomes in the study. Nagelkerke R^2 was used to assess the variability in hypertension explained by the independent variables in the final model. ROC curve analysis was done and AUC>0.7 was considered as good model fit to data.

RESULTS

Hypertension was present in 203 (40.6%) population; 150 males (73.8%) and 53 females (26.2%) were hypertensive. The hypertensive population increased as the age increased; significantly more males in each age group were hypertensive than females (p<0.01). Illiterate or those with primary education alone were at higher risk of hypertension in both the genders (p<0.05) compared to those with higher education. People with sedentary occupation were more hypertensive than those with occupation involving physical activity but the difference was not statistically significant both in males and females. Males who used to carry out leisure physical activity were significantly less hypertensive compared to those who did not (p<0.05). Similarly individuals who were in the habit of regular physical activity were less hypertensive than those who did not do physical activity regularly but the result was not statistically significant. Smoker population were more hypertensive compared to non-smokers, however the result was statistically significant only in men (p<0.05). As body mass index increased, percentage of people with hypertension increased significantly (p<0.01) both in men and women; obese were still at a greater risk than overweight population (Table 1).

Table 1: Covariates of hypertension.

Variable	Hypertensive Female			Hypertensive Male		
	No.	Percentage	P value	No	Percentage	P value
Age (years)						
≤30	5	14.7		39	31.5	
31-50	13	30.2	0.001	51	41.8	0.001
>50	35	50.0		60	56.1	
Education group						
Higher secondary	8	19.5		56	40.6	
Secondary	8	40.0	0.033	29	32.6	0.018
Primary & Illiterate	37	43.0		65	51.6	
Occupation						
Physical activity	11	25		89	40.6	
Sedentary	42	40.8	0.068	61	45.5	0.368
Leisure physical activity						
No	46	38.7		100	47.8	
Yes	7	25.0	0.176	50	34.7	0.019
Regular exercise						
No	46	37.7		108	44.3	
Yes	7	28.0	0.357	42	38.5	0.314
Smoking						
No	50	35.0		133	40.9	
Yes	3	75.0	0.100	17	60.7	0.042
Body Mass Index						
Not overweight	10	20.4		36	28.3	
Overweight	21	34.4	0.001	55	39.6	0.000
Obese	22	59.5		59	67.8	

Table 2: Severity of hypertension.

Variable	Number examined	Prehypertension		Hypertension grade 1		Hypertension grade 2	
		No.	%	No.	%	No.	%
Female	147	68	46.3	42	28.6	11	7.5
Male	353	165	46.7	119	33.7	31	8.8
Overall	500	233	46.6	161	32.2	42	8.4

Guidelines given by the seventh report of Joint National Committee on prevention, detection and treatment of hypertension were used for classifying the participants as hypertensive or normotensive. Overall 46.6% people were pre hypertensive, 32.2% had grade 1 hypertension and 8.4% had grade 2 hypertension. Percentage of males with grade 1 and 2 hypertension was higher than females (Table 2).

Logistic regression was performed after meeting the assumptions to ascertain the effects of age, gender, education, occupation, BMI, smoking and physical activity on the likelihood of participants having hypertension. In the univariate analysis, the statistical significance of individual regression coefficients was tested using the Wald's statistic. The regression results showed that increasing age was associated with increased likelihood of having hypertension. Odds ratio was 1.6 in the age group of 31 to 50 years (p<0.05) and the

likelihood increased to 3 times when the age increased to more than 50 years (p<0.01). Similarly the risk of hypertension was significantly more in overweight people (OR 1.7, p<0.05) and it increased to 5 times in obese population (p<0.01). People who attained only primary education or were illiterate were 1.6 times more likely to develop hypertension (p<0.05) compared to those with higher education. People with sedentary occupation and male gender were also more likely to develop hypertension but the results were not statistically significant. Smokers had increased likelihood of hypertension (OR 2.6, p<0.05) compared to non-smokers (Table 3).

Multivariate analysis with binary logistic regression was then carried out by backward LR method. It showed that age, gender, BMI and smoking were important predictors of hypertension in the study population. The model with these predictors provided a statistically significant

improvement over the constant only model; χ^2 (6) =75.920, p<0.001. The inferential goodness of fit test Hosmer-Lemeshow yielded a χ^2 (8)=3.914 and was insignificant (p>0.05); suggesting that the model was fit to the data well. Nagelkerke R^2 indicated that model accounted for 19% of total variance. The model correctly predicted 77.1% of cases where there was no hypertension and 53.2% of cases where there was hypertension; giving and overall correct prediction rate of 67.4%. Area under the ROC curve (AUC) was 0.721, p=0.000. Wald tests showed that all the above predictors significantly predicted the status of hypertension. Males were 1.5 times more likely to exhibit hypertension than females holding all the other variables constant (Table 4).

Table 3: Univariate logistic Regression with covariates of hypertension.

Variable	Beta coefficient	P value	Odds ratio	95% CI
Age (years)				
≤30	Reference	_	1	_
31-50	0.496	0.038	1.642	1.028-2.622
>50	1.099	0.000	3.002	1.902-4.738
Gender				
Female	Reference	_	1	_
Male	0.270	0.182	1.311	0.881-1.950
Education group				
Higher secondary	Reference	_	1	_
Secondary	-0.080	0.755	0.923	0.560-1.523
Primary & Illiterate	0.511	0.014	1.666	1.109-2.504
Occupation				
Physical activity	Reference	_	1	_
Sedentary	0.225	0.217	1.253	0.876-1.792
Leisure physical activity				
Yes	Reference	_	1	_
No	0.481	0.014	1.618	1.101-2.378
Regular exercise				
Yes	Reference	_	1	_
No	0.231	0.267	1.260	0.838-1.895
Smoking				
No	Reference	_	1	_
Yes	0.954	0.011	2.596	1.239-5.437
Body Mass Index				
Not overweight	Reference	_	1	_
Overweight	0.549	0.015	1.732	1.114-2.692
Obese	1.672	0.000	5.324	3.229-8.775

Table 4: Multiple logistic regression with covariates of hypertension.

Variable	Beta coefficient	P value	Odds ratio	95% CI
Age (years)				
≤30	Reference	_	1	_
>50	1.057	0.000	2.879	1.751-4.733
Gender				
Female	Reference	_	1	_
Male	0.449	0.044	1.567	1.012-2.426
Smoking				
No	Reference	_	1	_
Yes	1.062	0.010	2.893	1.290-6.486
Body Mass Index				
Not overweight	Reference	_	1	_
Obese	1.593	0.000	4.919	2.925-8.270

Odds ratio for smoking indicated that controlling all other variables, a smoker was 2.9 times more likely to have hypertension (p<0.01). Age was dummy coded using age less than 30 years as reference group. Only the age more than 50 years group was approved significantly (OR 1.7, p<0.001) more than the lesser age group. Similarly BMI was dummy coded with people not overweight as the reference group; only obese group of participants were proved significant predictor (OR 4.9, p<0.001) keeping all other variables constant (Figure 1).
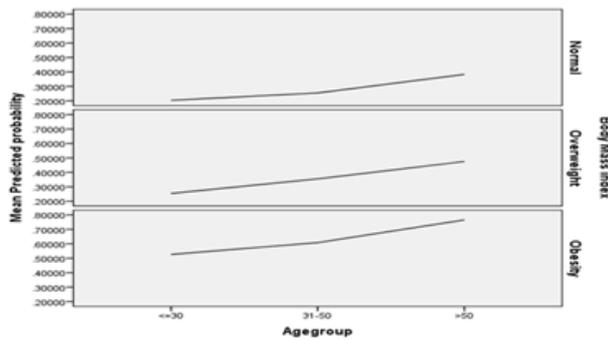
Figure 1: Predicted probability of hypertension vs BMI and age group of participants.

DISCUSSION

Hypertension was found in 40.6% of the study population which was higher than Hasab et al (27%) and Riyami et al (33.1%) in Oman.[12,5] The prevalence was higher in males than females but was not significant in Hasab et al study.[12] Benedicta et al found 46% people with hypertension with 76.7% males and 30.5% females.[13] Agarwal et al reported higher prevalence in males than females; while Whelton reported relative male preponderance below the age of 50 years.[14,15] Observed gender differences in hypertension, which exist, are due to both biological and behavioural factors. The biological factors include sex hormones, chromosomal differences, and other biological sex differences that are protective against hypertension in women.[16] Behavioural risk factors for hypertension include high body mass index and, to a lesser degree, smoking and low physical activity.[17-19] Men and women differ in these key behavioural risk factors in somewhat complex ways.

The present study found that people with age more than 50 years are 1.7 times more likely to have hypertension. In another study in Oman, hypertension was more in people above age 45 years and with less physical activity which is similar to our finding.[12] Gilbert et al also found that the prevalence of hypertension increases with advancement in age.[20] With increasing age, the aorta and arteries walls will be stiffened and this contributes to the high prevalence of hypertension in older age groups.[21] Another study from India also found that risk of hypertension increased in occupations involving sedentary work as compared to involving hard work as observed in the present study.[14] Though sedentary

individuals have increased risk of developing hypertension when compared to their more active and fit peers, the inverse relationship between blood pressure and aerobic physical activity in leisure time persists after adjustment for age, sex, BMI and workplace activity.[22]

Hypertension is a risk factor for cardiovascular disease and is typically obesity-related.[23] The present study found that obese people had 5 times more likelihood of developing hypertension. The result of this study agrees with the findings of previous investigators that have shown that the risk of hypertension increased with increasing BMI.[24,25] Adedoyin et al reported lower odds ratio of hypertension in obese individuals as 2.78. The rates of hypertension among the males in their study population were; 25.2%, 34.8%, and 48.3% for the normal, overweight, and obesity categories, respectively. While among the females, 25.0%, 36.9%, and 52.5% belonged to normal, overweight, and obesity categories, respectively.[26] Riyami et al found that hypertension was more in older age group, male gender and lower level of education, obese, smokers; these findings are similar to our study.[5]

Univariate analysis revealed that people with only primary education or those who are illiterate were 1.6 times more likely to develop hypertension. However, when adjusted effect of education on hypertension was observed by logistic regression, then no statistical association was seen. Increasing research indicates that the incidence and prevalence of hypertension is highly associated with social class as best measured by education and occupation.[27] Multivariate analysis of a European study (p=0.03) was independently associated with low educational level. Hypertension and its risk factors are relatively unknown to people with little education. Education is associated with greater health care and awareness that may overcome the risk related to low physical activity.[28]

Smokers had an odds ratio of 2.9 for developing hypertension in our study. Study suggests that cigarette smoking may be a modest but important risk factor for the development of hypertension. The significant odds ratios (and 95% confidence intervals) of smoking were 1.13 (1.03 to 1.23) for hypertension in a study by Dochi et al.[29] This study revealed that smoking is independently related to the onset of hypertension. Ruben et al found that compared with never smokers, past smokers and current smokers had corresponding relative risks of 1.08 and 1.15 of developing hypertension. The risk for smokers did not appear to differ based on number of cigarettes smoked daily.[30]

CONCLUSION

The study concluded that age more than 50 years, male gender, obesity and smoking were important predictors of hypertension in the study population in Oman. People with less education had more likelihood of hypertension.

Modifiable risk factors like smoking and obesity need appropriate and specific prevention strategy to combat hypertension by specific and targeted awareness campaigns in the community. This calls even for primordial prevention, societal changes and health promotion at an early stage of life to curb the epidemic of hypertension which increases the burden of other non-communicable diseases in the country as well.

ACKNOWLEDGEMENTS

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