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Combined Systolic Diastolic Hypertension among Adults in Saudi Arabia: Prevalence, Risk Factors and Predictors: Results of a National Survey

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ABSTRACT

Objective: *This study aims to determine the prevalence, risk factors, and predictors, of systolic diastolic hypertension among adults in the Kingdom of Saudi Arabia.* ***Methodology:*** *A community-based cross-sectional study using STEPwise approach among adults using a multistage, stratified, cluster random sample was carried out. Data were collected using questionnaires which included sociodemographic, blood pressure, biochemical, anthropometric measurements, and lifestyle practices. Statistical analysis included calculating means and standard deviations, proportions, univariate and multiple logistic regression analysis.* ***Results:*** *Of a total 4588 subjects, 413 (9.0%) suffered from systolic diastolic hypertension, which was significantly related to age, gender, employment, education, geographical location, smoking, physical activity, diabetes mellitus, obesity, and hypercholesteraemia. Significant predictors of systolic diastolic hypertension were male gender, advancing age, retirement, urbanization, diabetes, and hypercholesteraemia.* ***Conclusion:*** *Systolic diastolic hypertension is associated with some sociodemographic characteristics and co-morbidity. Given the various risks associated with systolic diastolic hypertension, the findings of this study emphasize the need for attempts to prevent and early diagnose the disease focusing on the modifiable risk factors.*

Keywords: Systolic-diastolic hypertension, Risk factors, Predictor's adults, Saudi Arabia

INTRODUCTION

Hypertension is a common health problem in most countries including Kingdom of Saudi Arabia (KSA) [1-5]. The cardiovascular disease risk factors (CVD) of hypertension are directly related to both systolic blood pressure (SBP) and diastolic blood pressure (DBP) levels [6]. This risk is direct, graded, and continuous over a wide range, apparently beginning at 115 mmHg systolic and 75 mmHg diastolic [7]. Subtypes of hypertension defined by isolated or combined elevations of systolic and diastolic blood pressure (BP) have gained wide clinical acceptance. They reflect "distinct pathophysiological mechanisms, have different prognostic implications, and may require a different therapeutic approach" [8]. A predominant rise in arteriolar resistance may lead to combined systolic-diastolic hypertension (SDH) if large artery stiffness also increases [8]. Guidelines from several authorities including KSA call for treating hypertensives to levels <140/85 mmHg [9-13]. Findings of Framingham study follow up showed that subjects with Isolated Diastolic Hypertension (IDH) were extremely more likely (23.1 times more likely) to develop SDH at follow-up [14]. Furthermore, subjects with normal or high-normal BP at entry were 3.32 and 7.96 times more likely, respectively, than those with optimal BP to develop SDH at follow-up [14]. The prevalence of SDH was 12.5% in KSA in the years 1995-2000 survey and it ranged from 7 to over 18% in other communities and from 25-65% within hypertensives patients [4,15-20]. The present study attempts to estimate the current prevalence of SDH, significant risk factors and predictors which were not previously addressed in depth to the best of our knowledge. The generated results of this study may be helpful for intervention strategies.

METHODS

This was a nationwide cross-sectional community-based survey in year 2005 targeting Saudi adults aged 15-64 years of age using the WHO STEPwise approach covering Non-Communicable Diseases (NCD) [21,22].

A multistage stratified cluster random sampling technique was used to recruit the study subjects. Stratification was

based on five age groups, 2 genders, 20 health regions and the Primary Health Care Centres (PHCCs) in each region. From each region 10% of these PHCCs were randomly chosen and the households a map of the health centre coverage area was used to choose the houses. The final sample selected was proportionate to the size of the catchment population in sampled PHCCs.

Data was collected using the WHO STEP-wise questionnaire which includes sociodemographic, life style habits, NCD, associated factors in addition to biochemical and blood pressure measurements. The questionnaire was translated into Arabic, pretested, readjusted before applying it. Data was collected by trained team, supervised by local and regional supervisors in addition to the national coordinator. The BP measurements were taken following the specified protocol using a digital sphygmomanometer. Three measurements were taken with 5 minutes intervals and the average of the three readings was calculated as the reading of BP for the subjects. The subject is labelled as having combined Systolic and Diastolic Hypertension (SDH) when the systolic pressure was 140 mmHg or above and the diastolic pressure is 90 mmHg or above. Collected data were fed into a computer and statistically analysed using SPSS package. Continuous variables are presented as mean ± standard deviation. Categorical variables are reported as numbers and percentages. Univariate analysis was performed for significant associations and multiple logistic regression analysis was performed to detect significant predictors for SDH. A p value of ≤ 0.05 was taken for statistical significance. The study was approved by the Institutional Review Board (IRB) of KFMC (log number 16-016).

Participants consents was obtained and confidentiality of data was assured and that data will be used only for the stated purpose of the survey. Further details of the method used and sampling procedures can be found in STEPwise documents and previous publications arising from the survey [21,22].

RESULTS

A total of 4758 subjects participated in the study, but only 4588 have complete questionnaires and were included in the final analysis giving a 96.6% response rate. The overall prevalence of hypertension was 20.7% (951 patients). The subjects with SDH were 413 (9.0%) of total subjects and (43.4%) of all hypertensives. Table 1 profiles the prevalence of SDH according to demographic characteristics and some life styles habits. Males constituted about 49% of the study population.

Table 1 Prevalence of Systolic Diastolic Hypertension (SDH) according to some socio-demographic and lifestyle characteristics

Characteristic	Total	Hypertensive		
	N (%)	Number	Percentage	P Value
Gender				
Male	2239 (48.8)	235	5.1	0.001
Female	2349 (51.2)	178	3.9	
Total	4588 (100)	413	9	
Age (Years)				
15-24	1021 (23.3)	23	0.5	<0.001
25-34	1082 (23.6)	33	0.7	
35-44	1141 (24.9)	101	2.2	
45-54	817 (17.8)	137	3	
55+	527 (11.5)	119	2.6	
Total	4175 (100)	413	9	
Education				
Non	1232 (26.9)	173	3.8	0.001
Primary	1167 (25.5)	112	2.4	
Intermediate	722 (15.8)	44	1	
Secondary	742 (16.2)	39	0.9	
University	597 (13.0)	40	0.9	
Vocational	119 (2.6)	1	0	
Total	4579	410	9	
Occupation				
Government employee	1326 (28.9)	115	2.5	0.001
Non-government employee	433 (9.5)	51	1.1	
Student	617 (13.5)	14	0.3	
Housekeeping	1709 (37.3)	152	3.3	
Retired	298 (6.5)	63	1.4	
Unemployed	198 (4.3)	19	0.4	
Total	4582 (100)	412	9	

Region				
Central	1105 (24.1)	135	2.9	-
Eastern	673 (14.7)	57	1.2	
Northern	413 (9.0)	48	1	
Western	1432 (31.2)	110	2.4	
Southern	965 (21.1)	63	1.4	
Total	4588 (100)		9	
Family Income (Saudi Riyals)				
<3000	1453 (33.4)	128	2.9	0.587
3000-6999	977 (22.5)	89	2	
7000- 9999	1272 (29.2)	103	2.4	
10000-14999	432 (9.9)	45	1	
15000+	216 (5.0)	16	0.4	
Total	4350 (100)	381	8.8	
Physical Activity				
High	734 (16.5)	45	1	0.006
Medium	738 (16.6)	56	1.3	
Low	2969 (66.9)	285	6.4	
Total	4441 (100)	386	8.7	
Fruits and vegetable consumption				
Below 5 serves per day	4335 (98.7)	382	8.7	0.39
5 + serves per day	57 (1.3)	6	0.1	
Total	4392 (100)	388	8.8	
Smoking status				
Currently daily smoker	500 (10.9)	28	0.6	-
Currently non-daily smoker	74 (1.6)	5	0.1	
Ex daily smoker	402 (8.8)	59	1.3	
Never daily smoker	3609 (78.8)	321	7	
Total	4585 (100)	413	9	

About a quarter of the subjects are in age group 35-44 years, with primary care education. The majority of the subjects are housekeepers (37.3%) and of the employed subjects about 29% work as government employees. About one third of subjects earn less than 3000 Saudi Riyals (800 US $). SDH was significantly associated with advancing age, male gender, lower educational level, housekeeping, regional location, low physical activity, low tobacco use. No significant association was detected for SDH with fruits and vegetables intake.

Table 2 Systolic Diastolic Hypertension (SDH) according anthropometric and some blood profiles

Variables	Hypertensive Mean (± SD)	Non-hypertensive Mean (± SD)	P value
Body Mass Index	30.6 (7.7)	27.7 (7.6)	0.001
Waist circumference(centimetres)	93.4 (19.5)	85.8 (18.2)	0.001
Hip circumference(centimetres)	105.9 (18.2)	101 (16.8)	0.001
Waist Hip ratio	0.89 (0.20)	0.85(0.16)	0.001
Glucose	7.1 (4.11)	5.7 (3.00)	0.001
Cholesterol	4.72 (1.33)	4.44 (1.53)	0.001
Triglycerides	1.80 (1.08)	1.61 (0.95)	0.011
High Density Lipoprotein	1.41 (0.86)	1.36 (0.79)	0.222

Table 2 shows the SDH according to some continuous variables including anthropometrics and blood levels of glucose and lipid profile. Significantly higher mean levels of all those parameters were associated with SDH except for high density lipoprotein. The significant predictors of SDH after controlling for age included urbanization, diabetes, male gender, hypercholesteraemia, obesity, lower education as depicted in Table 3.

Table 3 Logistic Regression analysis for predictors of systolic diastolic hypertension

Variables	B	S.E.	Wald	P value	O.R.*	95% C.I. for O.R.**	
						Lower	Upper
Education Literate	-0.308	0.138	4.973	0.026	0.735	0.561	0.963
Income	0.261	0.131	3.991	0.046	1.299	1.005	1.679
Body Mass Index	0.566	0.115	24.171	0	1.761	1.405	2.206

Cholesterol	0.247	0.126	3.862	0.049	1.28	1.001	1.638
Gender (Male)	0.416	0.126	10.878	0.001	1.515	1.184	1.94
Region (Rural)	-0.593	0.151	15.499	0	0.553	0.412	0.743
Diabetes	0.362	0.143	6.428	0.011	1.437	1.086	1.901
Constant	2.664	0.443	36.185	0	14.349	-	-
O.R.* = Odds Ratio							
95% C.I. for O.R.** = 95% Confidence Interval for Odds Ratio							

DISCUSSION

Elevated blood pressure is a leading risk factor for morbidity, disability, and mortality worldwide [1-6,23,24]. SDH as a subtype of hypertension disease arises from a combination of increased arterial stiffness along with a rise in arteriolar resistance. Researchers studied isolated and combined elevations in diastolic and systolic blood pressures. The resulting hypertension subtypes appear to reflect unique biological processes, perhaps with distinct clinical implications [8]. Understanding the pathophysiology and natural history of each subtype is vital for guidelines recommending prevention, control, treatment and follow up strategies. The pooling of all hypertension patients without consideration for different subtypes may have contributed to the limited success in identification of genetic variants involved in the aetiology of hypertension to date [17]. In this respect among untreated hypertensives, participants with SDH were at the highest risk for any cardiovascular event and time lost [19]. The prevalence of SDH in KSA according to this study is 9.0 % among adults 15-64 years of age. The previous survey (years 1995-2000) reported a crude prevalence of 12.5% but that was among adults aged 30-70 years of age [4]. SDH prevalence ranged from 7.5% to 18.4% in different communities. It was more than 18.0% in China [15] and 12 other communities worldwide [25]. At baseline, 13.8% of young-to-middle-age subjects were classified as having SDH [26]. Among hypertensives themselves SDH constituted 43.4 % in in KSA according to the results of this study this is in agreement with different studies in communities in Asia, United States of America and Africa which reported that SDH constituted 36-65% of all hypertensives [17,19,27-29]. As can be seen SDH constitutes a significant burden of hypertension in KSA and other communities worldwide which need to be addressed with effective strategies to reduce this burden. Identifying significant risk factors and predictors is crucial for such intervention strategies. This study revealed that SDH was significantly associated with many demographics and co morbidity but the significant predictors included urbanization, diabetes, age, gender, hypercholesteraemia, and obesity. Age is a significant predictor and risk factor reported by many studies worldwide including KSA [4,15-20,25-30]. The prevalence of SDH increased directly with age in subjects and throughout the age groups the prevalence of SDH was higher than in another hypertension subtypes [20]. Studies also reported obesity as a significant predictor of SDH in agreement with this study [4,15-20,25-30]. several studies indicate that obesity is associated with increased Arterial stiffness and various hemodynamic changes. This may contribute to hypertension and may not only impact the prevalence, but also the patterns of the disease [31,32]. As for gender, this study found that male have significantly higher SDH prevalence compared to females in agreement with some studies [16]. Other studies, however, reported that females were affected more than males. This was explained by the nature of the community where health seeking is considered as a feminine behaviour or females tended to be heavier, taller, and older than their male counterparts [17,33].

A more in-depth understanding of gender differences in the pathophysiology of blood pressure and hypertension subtypes is useful in tailoring and individualizing hypertension management [34]. Gender differences themselves may be confounded with other variables such as socioeconomic status, nutritional habits, and physical activity. In this study subjects with very low or very high income, those with low educational and intended physical activity level tend to have significantly higher prevalence of SDH. Similar results were reported from KSA previously [4]. Low socioeconomic status was associated with an increased SDH in some communities [32]. Low socioeconomic status may lead to lower health awareness, accessibility and utilization of health services particularly those of promotive and preventive nature which may lead to late detection of the disease. Geographical location in urban areas was a significant risk factor and predictor of SDH in KSA in this and previous studies [4]. Studies in other communities found significant differences in SDH prevalence when comparing urban with rural and plain with hilly areas [20,29,30,35]. Such variations in the distribution of hypertension subtypes across the communities might be related to different lifestyles, food habits and other risk factors for hypertension in addition to criteria adopted for defining subtypes of hypertension [20]. This study found significantly lower prevalence of SDH among smokers but not with vegetables and fruits consumption. The findings of some studies have shown an association between high fruit and vegetable consumption and low risk of hypertension. The magnitude of association varied by participants' characteristics, methods of diet assessment, outcome ascertainment, and duration of cohort follow-up. Higher intake of fruits and vegetables, as part of

a healthy dietary pattern, may only contribute a modest beneficial effect to hypertension prevention; possibly through improvement in body weight regulation [36]. Light alcohol intake and light cigarette smoking were associated with lower risks of SDH in some studies [30]. Alcohol consumption was not covered in this study due to religious concerns but smoking is highly prevalent and was associated with hypertension in previous studies. Hypercholesteraemia is a significant risk factor and predictor of SDH in this study in agreement with studies in other communities where dyslipidaemia is an important factor of different subtypes of hypertension [37].

CONCLUSION

This study confirmed the high prevalence of SDH among adults in the community and among hypertensives and identified modifiable risk factors and predictors. An intervention strategy is needed. This can make use of similar strategies suggested by the World Health Organization and others to improve prevention, detection, and treatment of hypertension, including SDH subtype [38,39].

Study limitations

The major limitation is the cross-sectional design, which cannot establish causal relations. The study subjects included only ages 15-64 years. Some variables which may have an association with SDH such as marital status and alcohol consumption were not included in the study. Because of the narrow diagnostic thresholds that define and separate non-hypertensive status and hypertensive subtypes, there is the possibility of misclassification of baseline data in addition to recall bias and confounding factors.

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