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Isolated Diastolic Hypertension among Adults in Saudi Arabia: Prevalence, Risk Factors, Predictors and Treatment. Results of a National Survey

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Background: In the past, diastolic hypertension was the main criterion for treatment, but currently, systolic pressure is the main criterion because it was thought that Isolated Diastolic Hypertension (IDH) is not associated with complications. Studies later revealed that IDH carries significant risks. Quantifying the magnitude and risk factors of IDH in the community is essential for all intervention strategies.
Aims: This study aims to determine the prevalence, risk factors, predictors, treatment modalities and lifestyle practices of IDH adult patients in the Kingdom of Saudi Arabia (KSA).
Study Design: Cross-sectional study.
Methods: A community-based cross-sectional study using STEPwise approach among adults using a multi-stage, stratified, cluster random sample was carried out. Data were collected using questionnaires which included socio-demographics, 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 4562 subjects, 180 (3.95%) suffered from IDH, which was significantly related to age, gender, employment, smoking, diabetes mellitus, obesity and hypercholesterolemia. More than 93% were using some form of treatment, with 77.2% on prescribed drugs, 63% using diet, and 23% using exercise. Significant predictors of IDH were retirement and hypercholesterolemia.
Conclusion: IDH is associated with some sociodemographic characteristics and co-morbidity. Given the risk of cardiovascular disease associated with IDH, the findings of this study emphasize the need for diagnosing the disease in middle-aged persons focusing on the modifiable risk factors of IDH.
Keywords: Adults, isolated diastolic hypertension, Saudi Arabia

Hypertension is a significant worldwide health problem, including the Kingdom of Saudi Arabia (KSA) (1-5). These problems are associated with both systolic blood pressure (SBP) and diastolic blood pressure (DBP) levels (6). Diastolic pressure was mostly the basis of clinical decisions but systolic blood pressure is thought to be more important, particularly among the elderly (7,8). This has resulted in greater emphasis being placed on systolic blood pressure, and isolated systolic hypertension (ISH) has been identified as a specific clinical entity. Isolated Diastolic Hypertension (IDH) was not recognized as a separate entity and some authors think that one should not even bother measuring DBP (9). Although current guidelines from several authorities including the KSA call for treating hypertensives at levels <140/85 mmHg (10-12). Many studies, however, emphasized the importance and benefits of treating diastolic hypertension in young adults (7,13-17). It has been recommended by many authors that IDH should be monitored and affected persons should be managed targeting

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the control of all cardiovascular risk factors (18). Previous surveys in KSA reported a 5.3% prevalence of IDH more than two decades ago (4). Studies in different countries reported a prevalence of IDH ranging from 2–8%, mostly associated with males, younger adults, and obese individuals (19-24). In this study, we will assess the current prevalence of IDH, characteristics, treatment modalities, patient' practices, risk factors and significant predictors which were not previously addressed to the best of our knowledge. It is hoped that such data can be helpful in the overall strategy for the prevention and control of hypertension and cardiovascular diseases.

MATERIALS AND METHODS

This was a cross-sectional national community-based study covering the whole of the Kingdom of Saudi Arabia in 2005. The WHO STEPwise approach to Surveillance (STEPS) of Non Communicable Diseases (NCD) risk factors was the basis for conducting the survey and collecting data (25,26). The study population were Saudi adults aged 15–64 years selected by a multistage stratified cluster random sampling technique. Stratification was based on age, gender and health regions of the country.

All primary health care centers (PHCCs) in each region were identified and listed and a 10% random sample was chosen. Households for each catchment area of each PHCC were identified and each house was given a number. A simple random sample was chosen from the households and selected households were visited for data collection. Data were collected by trained health care providers who were part of the health team in each PHCC. Data were collected using the standardized World Health Organization (WHO) questionnaire which was translated into Arabic and back-translated to ensure accuracy. The Arabic version was pilot tested for clarity and wordings of the questions. Questions related to alcohol use were not included in observations due to the religious and cultural norms of the community. The questionnaire include sociodemographic, health status, and lifestyle data, as well as anthropometric, biochemical and BP measurements. The measurements of BP were taken using a digital sphygmomanometer (OMRON B/P machine-digital automatic blood pressure monitor M4-1) following standardized procedures in subjects who rested quietly for five minutes with their legs uncrossed and their right arm unclothed. The appropriate cuff size was properly wrapped in the right arm placed on a table with the palm facing upwards. Pushing the 'START' button enabled the automatic inflation of the cuff and display of the reading of systolic blood pressure (SBP) and diastolic blood pressure (DBP) readings, which were recorded. A second reading was taken five minutes after the first and a third reading was taken five minutes after the second. The subject was labeled hypertensive if the average of the 3 blood pressure measurements was 140 mmHg or above for systolic and/or 90mmhg or above for diastolic blood pressure. Isolated diastolic is when diastolic pressure is 90 mmHg or above and systolic pressure is below 140 mmHg.

Statistical analysis

Collected data were checked and analyzed using the statistical software (SPSS Inc. Released 2008. SPSS Statistics for Windows, Version 17.0.; Chicago, IL, USA).

Descriptive statistics were used as follows: For quantitative variables, means and their related standard deviations, while qualitative variables were described in the form of frequency and percentages. The Chi-squared test was used to find any association between IDH and categories such as sociodemographic, lifestyle and comorbidity. Logistic regression analysis was used to determine predictors of IDH.

The study was approved by the Ministry of Health, Centre of Biomedical Ethics.

Informed consent of all subjects was obtained and confidentiality of data was assured.

RESULTS

A total of 4758 subjects participated in the study; 4562 were included in the final analysis giving an overall response rate of 95.9%. The overall prevalence of hypertension was 20.9% (951 patients). Table 1 profiles the demographic characteristics along with the prevalence of IDH. Males constituted about 49% of the study population. About a quarter of the subjects were in the age group 35–44 years, with primary care education. The majority of employed subjects work as government employees. About one third of subjects earn less than 3000 Saudi Riyals (800 US $). The prevalence of IDH was 3.95% (180 patients), constituting 18.9% of all hypertensives and about half of them (89 patients) were not aware of their disease; they discovered their illness for the first time during the survey. IDH was significantly associated with age, gender and occupation. It was significantly higher among males, in the age group 35–44 years and among government employees. IDH was not significantly associated with place, education or income. IDH was significantly higher among smokers, but it was not related to physical activity and diet, as shown in Table 2. Table 3 shows the prevalence of IDH according to some comorbidities. Isolated diastolic hypertension was significantly higher among obese subjects, as classified with BMI but not with central obesity and among hypercholesterolemic patients. Of the 91 known patients, 48.4% (44) were

TABLE 1. Prevalence of Isolated Diastolic Hypertension according to the sociodemographic characteristics

Characteristic	Total	Hypertensives		
	N (%)	Number	Percentage	p
Gender				
Male	2232 (48.9)	113	5.1	0.001
Female	2330 (51.1)	67	2.9	
Age (Years)				
15-24	1015 (22.2)	28	2.8	
25-34	1075 (23.6)	28	2.6	
35-44	1134 (24.9)	69	6.1	<0.001
45-54	810 (17.8)	40	4.9	
55+	528 (11.6)	15	2.8	
Education				
Non	1224 (26.9)	40	3.3	
Primary	1159 (25.5)	48	4.1	
Intermediate	721 (15.8)	25	3.5	0.226
Secondary	707 (16.2)	31	4.2	
University	692 (13.0)	33	5.6	
Vocational	119 (2.6)	3	2.5	
Occupation				
Government employee	1320 (29.0)	72	5.5	
Non-government employee	430 (9.4)	17	4.0	
Student	615 (13.5)	18	2.9	0.026
Housekeeping	1693 (37.2)	53	3.1	
Retired	300 (6.6)	13	4.3	
Unemployed	198 (4.3)	7	3.5	
Region				
Central	1098 (24.1)	51	4.6	
Eastern	669 (14.7)	27	4.0	
Northern	409 (9.0)	10	2.4	0.368
Western	1371 (31.2)	52	3.7	
Southern	963 (21.1)	40	4.2	
Family Income (Saudi Riyals)				
<3000	1446 (33.4)	55	3.8	
3000 – 6999	967 (22.4)	34	3.5	
7000 – 9999	1264 (29.2)	56	4.4	0.620
10000 – 14999	431 (10.0)	14	3.2	
15000+	216 (5.0)	11	5.1	

not undergoing treatment. Of the patients who were under treatment (47), about 93% were under some form of treatment suggested by a health professional. These modalities included drugs, diet, weight loss, exercise and quitting smoking. No patient consulted a traditional healer or used herbal medicines, as shown in Table 4. There were no significant differences in these practices according to the sociodemographic characteristics of subjects. All variables in the univariate analysis were analyzed again using multiple logistic regression for significant IDH predictors. Significant predictors for IDH were hypercholesterolemia and obesity, as depicted in Table 5.

TABLE 2. Prevalence of Isolated Diastolic Hypertension according to some lifestyle practices

Variable	Number	Percentage	p
Physical Activity			
High	26	3.6	
Medium	24	3.3	0.389
Low	125	4.2	
Ever Smoking			
Yes	48	4.9	0.048
No	132	3.7	
Fruits and vegetable consumption			
Below 5 serves per day	162	3.9	0.524
5 + serves per day	11	4.0	

TABLE 3. Prevalence of Isolated Diastolic Hypertension according to some comorbidities

Variable	Number	Percentage	p
Diabetes Mellitus			
Diabetic	33	4.8	0.112
Not diabetic	142	3.7	
Obesity (according to BMI)			
Obese BMI ≥30	78	4.8	0.016
Not obese	99	3.4	
Central Obesity:			
Yes	39	4.1	0.527
No	138	4.1	
Total cholesterol level			
Elevated ≥5.2 mmol/L	52	6.1	0.001
Not elevated	119	3.3	
High Density Lipoprotein			
Low ≤0.90 mmol/L	49	4.4	0.187
High	122	3.7	
Low Density Lipoprotein			
Elevated ≥3.5 mmol/L	59	4.5	0.065
Not elevated	105	3.5	

BMI: body mass index; mmol/L: mille mole per liter; ≥: equal to or more than; ≤: equal to or less than

DISCUSSION

The prevalence of IDH in KSA according to this study is 3.9% among adults aged 15-64 years and 6.3% in the group aged 35–44 years. It was 5.1% among adults over 30 years of age in a study two decades ago (4). Studies in other countries reported generally comparable prevalence rates among adults. The IDH prevalence was 4.5–6.7% in India (19,20), about 6% in Ethiopia and Nigeria (21,22), about 7.2% in Oman (23), 8.6% in young adults in the USA (18) and 4.4% in China (24). In this study, IDH was significantly more common among males, which is in agreement with many other studies. The group aged 35–44 years was the most affected age group in this study. Studies in other communities reported that IDH is more common in younger adults (7,8,19,24,27). The significant association of IDH with obesity agrees with the findings of other studies (19,28). The association of smoking with IDH in this study is not in agreement with other studies which revealed no significant association of smoking with IDH (19,29). Smoking habits are self-expressed and are subject to bias recall. It is difficult to ascertain smoking status without biochemical confirmation. This may explain the inconsistency of smoking with IDH. This study revealed no significant association with the level of physical activity. Other studies reported a significant association with of IDH with physical inactivity. There was no significant association of nutritional habits and practice and IDH in this study. Retired subjects in this study showed the highest IDH prevalence. This may have been confounded with age and other factors including income, and psychological stress. About half of the patients with IDH were not aware of their condition in this study; the majority of those who were aware were not under treatment and many of those undergoing treatment were not properly controlled. Studies in many communities reported generally comparable finding for hypertensive patients. This calls for intervention strategies to detect patients early, and the treat them, aiming for proper control. This can help to reduce complications and mortality. The most prevalent lifestyle modality used by patients was dietary modifications in the form of low salt, physical exercise, weight reduction and quitting smoking. Such lifestyle modifications and others known as non-pharmacological or non-drug therapies are practiced by many hypertensive and normotensives worldwide. They are uniformly recommended by the KSA and international agencies for hypertension as treatment guidelines (9-11). We fully agree with the remark of authors of studies that if IDH is not considered a separate entity, then the medical profession may deny treatment to many who require it (30,31). Not only treatment but also preventive and control measures targeting modifiable risk factors of IDH might be of greater public health importance (19). This study showed

TABLE 4. Treatment modalities and practices of patients with Isolated Diastolic Hypertension (n=47)

Variable	Number *	Practicing * %
Any treatment	24	51.1
Prescribed drugs by physicians	18	38.3
Diet	21	44.7
Weight loss	13	27.7
Quit smoking	3	6.4
Exercise	11	23.4
Traditional healers	0	0

*One patient can have more than one modality of treatment

TABLE 5. Multiple logistic regression for significant predictors of Isolated Diastolic Hypertension

						*95% CI Odds Ratio	
Predictor	B	S.E.	Wald	p	Odds Ratio	Lower	Upper
Region	-0.383-	0.294	1.700	0.192	0.682	0.383	1.213
Gender	0.284	0.239	1.415	0.234	1.328	0.832	2.121
Age	0.002	0.010	0.051	0.821	1.002	0.983	1.022
Occupation	0.104	0.069	2.268	0.132	1.109	0.969	1.269
Income	0.000	0.000	0.303	0.582	1.000	1.000	1.000
Smoking	-0.010-	0.303	0.001	0.975	0.990	0.547	1.795
Diet	0.676	1.034	0.427	0.513	1.966	0.259	14.909
Physical Activity	-0.109-	0.139	0.610	0.435	0.897	0.683	1.179
Obesity (BMI)	-0.222-	0.112	3.917	0.048	0.801	0.643	0.998
Central Obesity	0.042	0.260	0.026	0.872	1.043	0.626	1.737
Total Cholesterol	-0.205-	0.081	6.376	0.012	0.815	0.695	0.955
Triglycerides	-0.110-	0.091	1.468	0.226	0.895	0.749	1.071
Diabetes Mellitus	-0.290-	0.245	1.400	0.237	0.748	0.462	1.210
Constant	4.339	1.520	8.152	0.004	76.620		

CI: confidence interval; BMI: body mass index; B: natural log of the adjusted odds ratio; S.E.: standard error of B; Wald: Z-score test of sginificance of each predictor that IDH is associated with some sociodemographic characteristics such as gender and age and co-morbidity including obesity, diabetes and dyslipidemia. This emphasizes the need for diagnosing the disease in middle-aged persons particularly for male gender focusing on the modifiable risk factors of IDH including weight reduction, dietary factors and other lifestyle modifications.

Study limitations

The study is a cross-sectional design, mostly reflecting associations between IDH and its risk factors, and causation cannot be properly evaluated. Some data are recalled by subjects, so recall bias is expected.

Ethics Committee Approval: Ethics committee approval was received for this study from the Institutional Review Board, Ministry of Health, Centre of Biomedical Ethics.

Informed Consent: Written informed consent was obtained from household leaders who participated in this study.

Peer-review: Externally peer-reviewed.

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REFERENCES

1. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of worldwide data. *Lancet* 2005;365:217-23. **[CrossRef]**
2. Wang H, Dwyer-Lindgren L, Lofgren K, Rajaratnam JK, Marcus JR, Levin-Rector A, et al. Age-specific and sex-specific mortality in 187 countries, 1970-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 2012;380:2071-94. **[CrossRef]**
3. 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 J Hypertens* 2014;2014:564679. **[CrossRef]**
4. Al-Nozha MM, Abdullah M, Arafah MR, Khalil MZ, Khan NB, Al-Mazrou YY, et al. Hypertension in Saudi Arabia. *Saudi Med J* 2007;28:77-84.
5. Bromfield S, Muntner P. High blood pressure: the leading global burden of disease risk factor and the need for worldwide prevention programs. *Curr Hypertens Rep* 2013;15:134-6. **[CrossRef]**
6. Kannel WB. Role of blood pressure in cardiovascular morbidity and mortality. *Prog Cardiovasc Dis* 1974;27:5. **[CrossRef]**
7. Franklin SS, Pio JR, Wong ND, Larson MG, Leip EP, Vasan RS, et al. Predictors of new-onset diastolic and systolic hypertension: the Framingham Hear Study. *Circulation* 2005;111:1121-7. **[CrossRef]**
8. Franklin SS, Milagros JJ Wong ND, L'Italien GJ, Lapuerta P. Predominance of isolated systolic hypertension among middle-aged and elderly US hypertensives: analysis based on National Health and Nutrition Examination Survey (NHANESIII). *Hypertension* 2001;37:869-74. **[CrossRef]**
9 Sever P. Abandoning Diastole. *BMJ* 1999;318:1773-6. **[CrossRef]**
10 Saudi Hypertension Management Guidelines. National Commission for Hypertension & Saudi Hypertension Management Group 2007, KSA.
11. Whitworth JA; World Health Organization, International Society of Hypertension Writing Group. 2003 World Health Organization (WHO)/International Society of Hypertension (ISH) statement on management of hypertension. *J Hypertens* 2003;21:1983-92. **[CrossRef]**
12. Campbell N, Kaczorowski J, Lewanczuk R, Feldman R, Poirier L, Kwong M, et al; Canadian Hypertension Education Program. 2010 Canadian Hypertension Education Program (CHEP) recommendations: the scientific summary - an update of the 2010 theme and the science behind new CHEP recommendations. *Can J Cardiol* 2010;26:236-40. **[CrossRef]**
13. Swales JD. Systolic versus diastolic pressure: paradigm shift or cycle? *J Hum Hypertens* 2000;14:477-9.
14. Hozawa A, Ohkubo T, Nagai K, Kikuya M, Matsubara M, Tsuji I, et al. Prognosis of isolated systolic and isolated diastolic hypertension as assessed by self-measurement of blood pressure at home – the Ohasama study. *Arch Intern Med* 2000;160:3301-6. **[CrossRef]**
15 Veterans Administration Cooperative Study on Antihypertensive Agents: Effects of treatment on morbidity in hypertension. 1. Results in patients with diastolic blood pressures averaging 115 through 129 mm Hg. *JAMA* 1967;202:1028.
16. Arima H, Anderson C, Omae T, Woodward M, Hata J, Murakami Y, et al. PROGRESS Collaborative Group. Effects of blood pressure lowering on major vascular events among patients with isolated diastolic hypertension. the perindopril protection against recurrent stroke study (PROGRESS) trial. *Stroke* 2011;42:2339-41. **[CrossRef]**
17. Arima H, Murakami Y, Lam TH, Kim HC, Ueshima H, Woo J, et al; Asia Pacific Cohort Studies Collaboration. Effects of Prehypertension and Hypertension Subtype on Cardiovascular Disease in the Asia-Pacific Region. *Hypertension* 2012;59:1118-23. **[CrossRef]**

18. Beevers DG. Epidemiological, pathophysiological and clinical significance of systolic, diastolic and pulse pressure. *J Hum Hypertens* 2004;18:531e533.
19. Midha T, Lalchandani A, Nath B, Kumari R, Pandey U. Prevalence of isolated diastolic hypertension and associated risk factors among adults in Kanpur, India. *Indian Heart J* 2012;64:374-9. **[CrossRef]**
20. Biswas M, Manna CK. Prevalence of hypertension and sociodemographic factors within the Scheduled Caste community of the District Nadia, West Bengal, India. *High Blood Press Cardiovasc Prev* 2011;18:179-85. **[CrossRef]**
21. Tesfaye F, Byass P, Wall S. Population based prevalence of high blood pressure among adults in Addis Ababa: uncovering a silent epidemic. *BMC Cardiovasc Disord* 2009;9:39. **[CrossRef]**
22. Asekun-Olarinmoye E, Akinwusi P, Adebimpe W,Isawumi M , Hassan M, Olowe O, Makanjuola O, et al .Prevalence of hypertension in the rural adult population of Osun State, southwestern Nigeria. *Int J Gen Med* 2013;6:317-22. **[CrossRef]**
23. Al Riyami A, Elaty MA, Morsi M, Al Kharusi H, Al Shukaily W, Jaju S. Oman World Health Survey: Part 1 - Methodology, Sociodemographic Profile and Epidemiology of Non-Communicable Diseases in Oman. *Oman Med J* 2012;27:425-43.
24. Huang J, Wildman RP, Gu D, Muntner P, Su S, He J. Prevalence of isolated systolic and isolated diastolic hypertension subtypes in China. *Am J Hypertens* 2004;17:955-62. **[CrossRef]**
25. Bonita R, de Courten M, Dwyer T, Jamorzik K, Winkelmann R. Surveillance of risk factors for Non Communicable diseases. The WHO Stepwise approach: WHO, 2001.
26. STEPwise WHO.http://.www.who.int/chp/steps/2005_Saudi Arabia_STEPS_Report_EN.pdf
27. Rapsomaniki E, Timmis A, George J, Pujades-Rodriguez M, Shah A, Denaxas S, et al. Blood pressure and incidence of twelve cardiovascular diseases: lifetime risks, healthy life-years lost, and age-specific associations in 1.25 million people. *Lancet* 2014;383:1899-911. **[CrossRef]**
28. Primatesta P, Falaschetti E, Gupta S, Marmot MG, Poulter NR. Association between smoking and blood pressure: evidence from the health survey for England. *Hypertension* 2001;37:187-93. **[CrossRef]**
29. Chirinos JA, Franklin SS, Townsend RR, Rajj L. Body mass index and hypertension hemodynamic subtypes in the adult US population. *Arch Intern Med* 2009;169-80.**[CrossRef]**
30. Tin LL, Beevers DG, Lip GY. Systolic vs diastolic blood pressure and the burden of hypertension. *J Hum Hypertens* 2002;16:147-50. **[CrossRef]**
31. Luna RL, Luna LC. Is diastolic pressure losing its clinical usefulness? *Arq Bras Cardiol* 2007;89:e19-21.