1874-9445/20

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RESEARCH ARTICLE

Cardiovascular Diseases Risk Factors Among Young Adults: A STEPwise-Approach-Based Study in Three University Setups in Morocco

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Abstract:

Background:

Although chronic diseases, particularly cardiovascular diseases, are more likely to emerge during adulthood, their development begins earlier during childhood and adolescence. In this respect, we explored cardiovascular disease risk factors among students in three elite schools in Morocco.

Method:

The data collecting process was carried out using the French version of the STEPwise approach developed by the WHO to monitor Non-Communicable Diseases risk factors, producing thus standardized data and allowing wide comparability across similar studies. The investigation was conducted through on-site and online configurations. We only relied on the first and second sequences of the STEPS questionnaire in order to collect behavioral and physical data, on which our analysis was based. The choice of the population of Moroccan high intellectual potential youth is interesting, as they represent future physicians and leading engineers of tomorrow.

Results:

A total number of 325 subjects were surveyed. The prevalence of auto-reported diabetes and hypertension was respectively 3.31% and 8.54%. Alarmingly, a large proportion of respondents had undiagnosed hypertension. Besides, the prevalence of obesity was found to reach 6.17%, with no significant difference between gender groups.

Conclusion:

Hypertension appears to be largely undiagnosed which urges taking actions towards raising awareness among youth about chronic diseases and their risk factors as well as highlighting their preventability to prevent their future development.

Keywords: Obesity, Hypertension, Public health, Young adults, STEPwise approach.

Article History	Received: May 4, 2020	Revised: August 01, 2020	Accepted: August 07, 2020

1. INTRODUCTION

The rise of Non-Communicable Diseases[4] (NCDs henceforth) and the subsequent shifts in the worldwide morbidity and mortality trends have placed the issue of NCDs at the top of the research agenda for health officials as well as other stakeholders, in all countries irrespective of their development stages. Research treating the issue has explored the implications of NCDs from different perspectives, including medical, epidemiological, social and economic standpoints.

Currently, NCDs are the leading cause of mortality and disability worldwide [1] yet the associated risk factors are identifiable and preventable [2]. In fact, etiologic research has shed light on the causal and preventable nature of factors associated with the development of NCDs, especially for the case of cardiovascular diseases, which represent the main NCD that claims most lives globally [3]. The development of NCDs is related to behavioral factors such as tobacco and alcohol

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DOI: 10.2174/1874944502013010464, 2020, *13*, 464-469

consumption as well as sedentary lifestyles, and other factors that exhibit complex interdependencies with these behavioral factors, such as obesity and hypertension.

The shift of focus from infectious diseases to NCDs and the emergence of the notion of *risk factors* are the result of the landmark epidemiological study of Framingham initiated in 1947 [4]. This –still ongoing– study has established causal links between cardiovascular diseases and physical, behavioral, as well as psychosocial factors. Further epidemiological research has been developed upon these causal liaisons and strove to enhance the predictability of cardiovascular events through more refined methodologies. In particular, cardiovascular disease forecasting algorithms, such as the ones developed under the QRESEARCH study, namely QRISK1 and QRISK2 algorithms, which have been developed using medical files of a cohort of more than 24 million subjects [4, 5]. However, this research criticized conclusions drawn from Framingham-study-based algorithms that may overestimate risk in affluent areas and underestimate it in poor ones, hence introducing variables related to socioeconomic inequalities in the first forecasting equation [5] and variables related to clinical conditions in the second one [6].

Moreover, epidemiological research highlighted the fact that NCDs, mainly cardiovascular disease risk factors, are easily identifiable and quite preventable. In that respect, the literature insisted on the preponderance of hypertension as the most important risk factor. Hypertension is present in the etiology of ischemic cardiomyopathy, renal diseases and dementia, and it is the most frequent factor in stroke cases [7]. Thus, immediate and intensive treatment of hypertension would reduce the mortality risk associated with its complications.

Accordingly, controlling and preventing cardiovascular risk factors would decrease the risk of cardiovascular events. In fact, a reduction to recommended levels of HbA1c, Systolic Blood Pressure (SPB), tobacco consumption and High-Density Lipoprotein (HDL) have decreased the occurrence of coronary heart diseases among a cohort of American adults with diabetes by 38% for 10 years [8]. However, a more drastic reduction to below-recommended levels would prevent up to 55% of coronary heart disease events, for over 10 years (8). Furthermore, preventive actions are not only effective in reducing the epidemiological burden, but they also are cost-effective. A study done by Barton *et al.* showed that reducing the risk of a cardiovascular event by 1% would prevent 25 000 cases of cardiovascular diseases and 3 500 related deaths, as well as savings achieving £265 million [9]. In sum, prevention is a key factor in controlling the burden of chronic diseases; however, its time-deferred effect makes it politically less attractive.

Although chronic diseases are more likely to emerge during adulthood, their development begins earlier during childhood and adolescence [10]. As a matter of fact, this aspect is still overlooked in the cardiovascular epidemiology literature, especially the relationship between asymptotic atherosclerosis and cardiovascular risk factors at young ages [11]. In particular, cardiovascular events are mainly caused by thrombosis emerging from the long and complex process of atherosclerosis, which begins in early childhood [12, 13], as well as the apparition of fibrotic lesions in the coronary arterial system later in adolescence [14], as the severity of atherosclerotic lesions are not only related to the mere presence of risk factors but also to the overtime exposure to disease factors, which are likely to reinforce each other [11]. Correspondingly, results from Berenson *et al.* [11] show an increase in the prevalence of fatty streaks in the coronary arteries from an age as early as 2 years old, to 85% at the age of 21-39 years [11]. Accordingly, the promotion of physical activity during childhood and early adolescence is shown to reduce the risk of future occurrence of cardiovascular diseases in middle age [10].

The present study aims to analyze cardiovascular diseases risk factors trends among students in three elite engineering and medical schools. The study of this particular population is of interest because: firstly, the development of cardiovascular begins early in life and preventive actions may be efficient during early adulthood. Secondly, the assessment of health behaviors of medical and engineering students in these elite schools is interesting as they represent the physicians of tomorrow as well as role models in the Moroccan society.

2. METHODS

2.1. Research Design

The present paper describes epidemiological data collected in a cross-sectional framework at 3 university setups in Morocco. The study surveyed essentially young adults, aged between 18 and 29 years old. The data collecting process was carried out using the French version of the STEPwise approach developed by WHO to monitor NCDs risk factors, producing thus standardized data and allowing wide comparability.

The STEPwise approach is based on a sequential procedure. The first step consists of collecting demographic and behavioral data. This first part is divided into six modules, addressing past and present tobacco consumption and tobacco smoke exposure, alcohol consumption frequency and quantity, eating habits, physical activity including occupational, leisure and traveling from one place to another, and history of high blood pressure and diabetes. The second step is concerned with physical measurements, such as height, weight, waist and hip circumferences, as well as heart rate and blood pressure. These measurements provided data to compute the Body Mass Index (BMI), and the waist to hip ratio. A third step is included in the questionnaire, which is related to biochemical measurements using blood samples. These measurements concern blood glucose, blood lipids, urinary sodium and creatinine, triglycerides and high-density lipoprotein (HDL) cholesterol.

In the present paper, we only rely on the first and second sequences of the STEPS questionnaire in order to collect behavioral and physical data, on which our analysis was based. We excluded subjects who refused to take part in the study and signed consents were collected from subjects who wished to participate. This study was conducted in compliance with the Helsinki Declaration and the ethical standards of the responsible institution on human subjects. Also, the study was approved by the Ethics Committee of the Mohammed VI University Hospital of Marrakesh.

2.2. Data collecting and Analysis Process

The investigation was conducted through on-site and online configurations. In the on-site configuration, the investigators were physically present on the site and proceeded manually to collect data through the administration of a paper version of the STEPS questionnaire and taking physical measurements with the help of trained paramedical personnel. As for the online version of the survey, it was developed by a group of engineering students, which provided more flexibility in the data collecting process. The online version was designed to ensure maximum confidentiality, as every potential subject received a secure and personalized link to the survey. However, in that configuration, subjects proceeded themselves to take physical measurements and put them in the online form.

The study was conducted on three university setups from the region of Marrakesh-Safi, Morocco, including a top-tier engineering school and a medical school. The paper-based version of the survey was present in both the first and the second sites. However, only the online version was administered to subjects in the third site. Subjects have been informed by email about the study and were asked to participate actively.

The data analysis process consisted of piling up data from the three investigation sites and merging them into a single database. Then, a series of descriptive statistical analyses were run to sort out the main trends in the data, and two-sample t-tests were performed to compare the means between gender groups, as shown in the next section.

It should be noted that our sample may be subject to selection bias, as the participation in the study was solely based on the volunteering of participants.

3. RESULTS

The descriptive and analytical characteristics of the surveyed sample are reported in Table **1**. A total of 325 subjects were surveyed, of which 200 (60.54%) were females. On average, the age of the subjects was 20.99 (±2.741) years, and 91.41% of the sample falls between 18 and 25 years. The global response rate was quite low for the online version of the survey, since a total of 2 627 emails were sent. Setups, where paper surveys were available, had slightly higher response rates, ranging from 30.5% in the first setup to 74.7% in the second.

The prevalence of smoking was reported to be 7.58% in our sample, with daily consumption of 5.84 cigarettes a day (3.272–8.419). Additionally, 75% of our sample began smoking at the age of 19 or earlier.

Data analysis showed that respondents had an average fruit intake of 2.52 servings per day (2.058–2.992), with no significant difference between gender groups [females: 2.77 (2.056–3.501), males: 2.08 (1.862–2.299), P-value=0.069]. As for the vegetable intake, respondents reported having an average intake of 3.147 servings/day (2.502–3.792), with no significant difference between genders [females: 3.357 (2.349–4.366), males: 2.787 (2.475–3.099)]. In addition, an average leisure physical activity of 2.2 hours/day (2.009–2.404) was reported, with a significant difference between genders [females: 1.946 (1.699–2.193), males: 2.513 (2.204–2.822), P-value=0.005]. Moreover, the prevalence of obesity was 6.17%, with no difference between gender groups [females: 3.09%, males: 3.09%], and that of overweight attained 16.62% [females: 9.88%, males: 6.79%].

The prevalence of auto-reported diabetes and hypertension was respectively 3.31% and 8.54%. At the same time, according to our measurements of the systolic and diastolic blood pressure, the prevalence of raised blood pressure attained 42.69%, with a mean systolic and diastolic blood pressure of 118.046 mmHg (116.403–119.689) and 73.799 mmHg (72.509–75.089), respectively.

Table 1. Frequencies and prevalence of risk factors among enrolled young adults.

Factor	N	Overall	Male	Female	P-value
Overall	343	343 (100,00%)*	126 (36,73%)	217 (63,27%)	-
Age	343	20,991	20,754	21,201	0.521
		[20,774 ; 21,209]**	[20,122 ; 21,386]	[20,804 ; 21,598]	
Tobacco consumption	343	26 (7,58%)	15 (4,37%)	11 (3,21%)	0.037
Daily smoking	26	15 (57,69%)	9 (34,62%)	6 (23,08%)	0.791
Age at smoking initiation	16	19,125	20,2	17,33	0.051
		[17,582 ; 20,667]	[18,046 ; 22,354]	[15,619 ; 19,047]	
Quantity of industrial cigarettes consumed per day	13	5.84	5.375	6.6	0.635
		[3.272 ; 8.419]	[3.013 ; 7.736]	[-1.183 ; 14.383]	
Alcohol consumption	340	47 (13,82%)	23 (6,76%)	24 (7,06%)	0.085
Consumption frequency					
5-6 days per week	46	16 (34,78%)	9 (19,57%)	7 (15,22%)	-
1-4 days per week	46	8 (17,39%)	3 (6,52%)	5 (10,87%)	-
1-3 days per month	46	15 (32,61%)	7 (15,22%)	8 (17,39%)	-
less than once per month	46	7 (15,22%)	3 (6,52%)	4 (8,70%)	-
Average number of standard drinks consumed during a drinking occasion	24	3,708	6	2,071	0.65
		[1,706: 5,710]	[1,195 ; 10,804]	[1,338 ; 2,804]	

(Table 1) contd.....

Factor	N	Overall	Male	Female	P-value
Largest number of drinks consumed during a drinking occasion	23	4	4,666	3,571	0.414
		[2,675 ; 5,323]	[1,842 ; 7,490]	[2,040 ; 5,102]	
Number of fruit servings consumed during a day	256	2,52	2,08	2,779	0.069
		[2,062 ; 2,992]	[1,862 ; 2,299]	[2,056 ; 3,501]	
Number of vegetable servings consumed during a day	218	3,151	2,787	3,357	0.286
		[2,509 ; 3,793]	[2,475 ; 3.099]	[2,349 ; 4,366]	
Travelling to and from places walking or cycling for at least 10 minutes continuously	322	184 (57,14%)	80 (24,84%)	104 (32,30%)	0.007
Time spent travelling to and from places by walking or cycling on a typical day (in minutes)	183	62,666	588,125	65,66	0.612
		[48,327 ; 77,005]	[45,784 ; 72,188]	[41,836 ; 89,483]	
Vigorous-intensity leisure activities that cause large increases in breathing or heart rate for at least 10 minutes continuously	319	142 (44,51%)	70 (21,94%)	72 (22,57%)	0.968
Time spent doing vigorous-intensity leisure activities (in minutes)	141	83,893	89,619	78,085	0.097
		[77,009 ; 90,777]	[79,963 ; 99,276]	[68,218 ; 87,952]	
Moderate-intensity leisure activities that cause large increases in breathing or heart rate for at least 10 minutes continuously	315	149 (47,30%)	71 (22,54%)	78 (24,76%)	0
Time spent doing moderate-intensity leisure activities (in minutes)	148	83,797	90,071	78,166	0.147
		[75,873 ; 91,720]	[76,250 ; 103,85]	[69,541 ; 86,791]	
Time spent sitting or reclining on a typical day (in minutes)	315	587,66	551,016	609,908	0.177
		[544,804 ; 630,51]	[486,416 ; 615,61]	[553,091 ; 664,72]	
Self-reported raised blood pressure	246	21 (8,54%)	6 (2,44%)	15 (6,10%)	0.658
Measured blood pressure					
Normal blood pressure	253	145 (57.31%)	39 (15.42%)	106 (41.9%)	0
Raised blood pressure	253	85 (33.60%)	43 (17.00%)	42 (16.6%)	0.002
Stage 1 hypertension	253	16 (6.32%)	11 (4.35%)	5 (1.98%)	0.02
Stage 2 hypertension	253	7 (2.77%)	2 (0.79%)	5 (1.98%)	0.603
Diabetes	151	5 (3,31%)	1 (0,66%)	4 (2,65%)	0.464
Body Mass Index	325	23,308	22,793	24,143	0.176
		[22,408 ; 24,208]	[21,777 ; 23,809]	[22,445 ; 25,880]	
Severe underweight	324	3 (0,93%)	0 (0,00%)	3 (0,93%)	0.083
Moderate underweight	324	6 (1,85%)	3 (0,93%)	3 (0,96%)	0.554
Underweight	324	22 (6,79%)	6 (1,85%)	16 (4,94%)	0.273
Normal weight	324	219 (67,59%)	81 (25,00%)	138 (42,59%)	0.721
Overweight	324	51 (16,67%)	22 (6,79%)	32 (9,88%)	0.609
Obesity class 1	324	14 (4,32%)	7 (2,16%)	7 (2,16%)	0.359
Obesity class 2	324	3 (0,93%)	1 (0,31%)	2 (0,62%)	0.363
Obesity class 3	324	3 (0,93%)	1 (0,31%)	2 (0,62%)	0.877

*Percentages are reported between parentheses
**95% confidence intervals are reported between accolades

4. DISCUSSION

In our study, we investigated the distribution of cardiovascular risk factors among students in three elite engineering and medical schools. The investigated risk factors include the consumption of tobacco and alcohol, eating habits, physical activity levels, obesity, hypertension, and self-reported cases of diabetes mellitus.

4.1. Tobacco and Alcohol Consumption

Smoking is known to be the most important public health issue and also the most preventable cardiovascular risk factor [15]. In our sample, we found that nearly 7.58% of young adults in our sample are currently smoking, and six in ten young adults who are current smokers consume tobacco daily, with an average consumption of 5.84 cigarettes per day (3.272-8.419). These findings are in line with those of a 2008 STEPS survey in Iran, where the prevalence of tobacco smoking among youngsters aged between 15 and 24 years was 9.1% (6.8–11.9), with daily consumption of 13.1 (6.1–20.1) industrial cigarettes [16]. However, according to a STEPwise-approach-based study in Brunei in 2016 [17], the prevalence of smoking was 20.0% (17.2–22.7) among youth aged between 18 and 29 years. On a national scale, the prevalence of smoking in 2017 was reported to be 45.4% among the population above 15 years old [18].

Even though it is prohibited to sell alcohol to Muslims in Morocco, heavy drinking is frequent among Moroccan people, with a proportion of 53.7% of heavy drinkers among current drinkers [19]. In our sample, the prevalence of alcohol drinking is estimated to be 13.82%, with no significant difference between genders. The same trend was observed among youth from the province of Khemisset, Morocco, where the prevalence of alcohol consumption is estimated to be 15.6% [20].

4.2. Hypertension

Hypertension appears to be highly undiagnosed in our sample. In fact, a proportion of 42.69% in our sample had high levels of blood pressure, with 9.09% may be having either stage 1 or stage 2 hypertension. These findings are in line with Al-Majed & Sadek (2012) [21]which is based on a similar sample with a mean systolic and diastolic blood pressure of 116.16 and 76.02, compared to the mean systolic and diastolic blood pressure in our sample that was estimated to be 118.046 mmHg (116.403–119.689) and 73.799 mmHg (72.509–75.089), respectively [21].

4.3. Diet, Obesity and Physical Activity

As for fruit and vegetable consumption, we reported that subjects consume on average 2.52 fruit servings and 3.15 vegetable servings per day, which is way below the recommended five servings a day [22]. Correspondingly, youth in Iran have less fruit and vegetable intake than recommended, as they consume on average 1.49 fruit servings and 1.40 vegetable servings per day.

The prevalence of obesity reached in our sample to 6.17% and nearly two in ten young adults have either obesity or overweight, with a mean BMI of 23.30%. Wittekind *et al.* [23] reported a mean BMI of 36 using a similar sample, and Baig *et al.* [24] reported an obesity prevalence of 18.6% in a similar university setup.

Furthermore, by examining pairwise correlation coefficients, it appears that subjects with higher physical activity levels had lower, but non-significant, Body Mass Index [BMI/Total physical activity time: -0.05, P-value=0.432]. Similarly, there was no significant correlation between fruit and vegetable intake, and BMI [fruit and vegetable intake/BMI: -0.0337, P-value=0.6452]. On the other hand, subjects with higher fruits and vegetable intake had significantly lower waist circumference, as suggested by the pairwise correlation coefficients [fruit and vegetable intake/waist circumference: -0.250, P-value=0.001]. Likewise, there was a negative and significant correlation between tobacco consumption and physical activity levels [Cigarettes smoked/total physical activity time: -0.751, P-value=0.019].

This exploratory study showed that cardiovascular risk factor trends among elite young adults can be of concern and urge the need for an in-depth exploration *via* a thorough nationwide study to provide a strong basis for preventive actions.

CONCLUSION

In summary, exploring the distribution of cardiovascular risk factors among youth is primordial as the development of chronic diseases begins in the early stages of life, yet it is a neglected issue in the literature [21]. This study showed that young population is not completely exempt from cardiovascular disease risk factors, as hypertension is quite prevalent among young adults in our sample, which is considered as the most important risk factor for cardiovascular diseases [7]. Furthermore, hypertension appears to be largely undiagnosed in our sample, which urges taking actions towards raising awareness among youth about chronic diseases risk factors and highlighting their preventability as well as promoting healthy lifestyles in order to prevent future disease development. Thus, this study needs to be extended to include a nationally representative sample and further “steps” in the WHO STEPwise process for collecting risk factors data to ensure rigor, comparability, and reduce risk of selection and information bias.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No human or animals were used in this research.

INFORMED CONSENT

Potential participants were informed about the objectives of the study and provided signed consents before enrolment in the study.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request. The data are not publicly available due to privacy or ethical restrictions

FUNDING

This research was fully funded by Mohammed VI Polytechnic University in Ben Guerir, Morocco.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

ACKNOWLEDGMENTS

The authors wish to thank Mohamed Soussou, Zaid Lemouakni, and Rania Msiyah for developing the online version of the survey and ensuring the complete confidentiality of the collected data.

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