Biophysical, behavioural, and anthropometric factors in predisposition of non-communicable diseases in adults attending healthy lifestyle centres in Kalutara district

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Abstract

Introduction: We conducted our research to identify the association of biophysical, behavioural, and anthropometric factors in predisposition of Non-Communicable Diseases (NCDs) as NCDs are a major public health challenge in Sri Lanka as a developing country.

Objectives: To determine the association of biophysical, behavioural and anthropometric factors in predisposition of NCDs in adults attending Healthy lifestyle centres (HLCs) in Kalutara district.

Methods: A descriptive cross-sectional study was performed using secondary data collected from HLCs records of 482 adults between the ages of 30 – 60 years. A multistage sampling method was used. Data collection instrument was Epicollect5 Data Collection application. WHO criteria were used in classification of risk levels of anthropometric and biophysical factors associated with NCDs. Data was analysed using SPSS software. Chi squared test was used to find the associations and P value < 0.05 was considered as significant.

Results: A statistically significant difference was observed in serum cholesterol level with diastolic blood pressure (DBP) (p=0.045) and random blood sugar level (RBS) (p=0.017). Physical activity showed statistically significant differences with waist to height ratio (WHtR) (p=0.005), systolic blood pressure (SBP) (p=0.009) and diastolic blood pressure (DBP) (p=0.010). Statistically significant differences were observed in tobacco consumption with waist circumference (WC) (p<0.001), WHtR(p=0.032), RBS (p=0.045) and serum cholesterol level (p=0.038). SBP (p<0.001) and DBP (p<0.001) showed significant associations with body mass index (BMI). WC also showed statistically significant differences with SBP (p=0.044) and DBP(p=0.006).

Conclusions: this study revealed that most of the biophysical, behavioural and anthropometric factors were considerably associated with predisposition of NCD.

Keywords: NCD, Biophysical, Behavioural, Anthropometric

Biophysical, behavioural, and anthropometric factors

Introduction

Non-Communicable Diseases (NCDs) are defined as diseases of long duration, with slow progression [1]. Cardiovascular diseases (CVDs), diabetes, hypertension, cancer, kidney diseases and non-alcoholic fatty liver diseases are considered as NCDs [2]. In our research, we have only considered risk factors for CVDs, diabetes, and hypertension. These NCDs are mainly caused by four modifiable behavioural risk factors which are tobacco use, unhealthy diet, physical inactivity, and harmful use of alcohol [1].

NCDs are the principal causes of death worldwide, killing more people each year than all other causes combined [3]. The burden of NCD causes serious implications on social and economic development worldwide, particularly for lower- and middle-income countries [3]. The costs in the health-care systems for NCDs are very high and rising [4].

NCDs are strongly influenced by behavioural risk factors which lead to elevated blood pressure, blood glucose and cholesterol levels [4]. A 'risk factor' refers to any, attribute, characteristic, or exposure of an individual which increases the likelihood of developing NCDs [5]. Most NCDs have been strongly associated with behaviours such as tobacco use, physical inactivity, unhealthy diet, and harmful use of alcohol [6]. Common biophysical risk factors which predispose a person for NCDs are high blood pressure, high blood sugar, BMI and WHtR [7].

Raised blood pressure is defined as a SBP ≥140 mmHg and/or DBP ≥90 mmHg [8]. Age standardized prevalence of raised blood glucose among people above 18years, defined as fasting blood sugar (FBS) ≥126 mg/dl or on medication for raised blood glucose. Age standardized prevalence of raised total cholesterol among people above 18years is defined as total cholesterol ≥5.0 mmol/l or 190 mg/dl [9].

Regular sufficient physical activity is defined as at least 150 minutes of moderate-intensity physical activity per week for adults [10].

BMI and WC are generally used tools to identify the risk of NCD [11].

As NCDs are the leading cause of death in Sri Lanka, HLCs have been established in the Western Province in 2011 with the aim of reducing the number of NCD related deaths. These clinics have basic facilities to provide health guidance, screening, basic treatment, referral and follow up for target population, age between 30-65 years who are previously undiagnosed for NCDs.

The HLCs are conducted by Medical Officers (MO)/Registered Medical Officers in primary health care institutions and MO/public health, MO/health promotion or any other medical officer in other institutions. At least 3 HLCs per each MOOH area are established in Western Province and total of 23 HLCs are in Kalutara district. These centres are under supervision of provincial director health services and regional director health services at each district [12].

Methods

Ethical approval from ethics review committee of Faculty of Medical Sciences, University of Sri Jayewardenepura, and approval from the Regional Director of Health Services, Kalutara was obtained. A pre-test and a pilot study were done before the proper data collection. A descriptive cross-sectional study was performed from August to October 2021 using secondary data available at randomly selected 4 HLCs in Kalutara district. HLC records of 482 adults between the ages of 30 – 60 years who attended Katugahahena, Dodangoda, Bandaragama and Bulathsinhala HLCs from March to September 2021 were collected using a multistage sampling method to achieve the sample size. HLC records of individuals without proper data entry were excluded. Records with more than two empty data fields were considered as records without proper data entry.

Data collection instrument was Epicollect5 data collection application. WHO criteria were used in classification of risk level of anthropometric and biophysical factors associated with NCDs. SBP ≤120mmHg and DBP ≤80mmHg were taken as normal blood pressure values. Blood pressure has been recorded using only one reading in clinic setting. FBS values of ≥126 mg/dl and the Random Blood Sugar (RBS) ≥200 mg/ dl was considered to be higher than normal. Raised cholesterol level was taken as blood cholesterol level of 5mmol/L (190mg/dl) or higher. BMI of more than 24.9kg/m2 was taken as overweight and 0.05 or higher value of waist to height ratio was taken as increased value. Waist circumference less than 90cm was taken as normal for men and waist circumference less than 80cm was taken as normal for women. Data was analysed using SPSS software. P value < 0.05 was considered as significant. Chi squared test was used to find the associations between behavioural and anthropometric factors with biophysical factors and associations of biophysical factors between each other. For the calculation of the NCD risk of the population 0 and 1 points were given for negative and positive factors for the predisposition of NCD respectively as stated above and then the total score was calculated. Skewness was calculated for the population with regard to distribution of biophysical, behavioural, and anthropometric factors using SPSS. Mean and median were used to divide the population as high risk and low risk categories. If the skewness was less than 1 mean was used as the cut off level and if the skewness was more than 1 median was used as the cut off level to divide as high risk and low risk. FBS level was not considered in calculation of the risk as its response rate was very low.

Results

Risk of developing NCDs in adults attending HLCs

Out of 393 participants 183 (46.6%) were in high risk of having NCDs according to the accumulative effect of biophysical, behavioural, and anthropometric factors. Out of 480 participants 299 (62.3%) were in high risk to have NCDs according to anthropometric factors. According to biophysical factors, 239 (60.8%) were in high risk to have NCDs out of 393 participants and out of 482 participants 226 (46.9%) were in high risk to have NCDs according to behavioural factors.

According to table 1 there were statistically significant differences between serum cholesterol level with DBP ($\chi^2 = 4.0$, df = 1, p = 0.045) RBS ($\chi^2 = 5.7$, df = 1, p = 0.017). DBP and RBS were significantly higher in participants with high serum cholesterol level.

According to table 2 there was a statistically significant difference between physical activity and WHtR (χ 2 =8.0, df = 1, p = 0.005). WHtR was significantly higher in physically active participants.

Statistically significant differences were observed between physical activity with SBP (χ 2 = 6.8, df = 1, p = 0.009) and DBP (χ 2= 6.6, df = 1, p = 0.010). SBP and DBP were significantly higher in physically active participants.

Table 1: **Association of serum cholesterol level with SBP, DBP and RBS**

		Serum cholesterol		*Total (%)*	*Significance*
		Normal (%)	*High (%)*		
SBP					
	Normal	77 (49.7)	78 (50.3)	155 (100.0)	$\chi^2 = 2.2$ df = 1 p = 0.140
	High	136 (42.5)	184 (57.5)	320 (100.0)	
DBP					
	Normal	114 (49.6)	116 (50.4)	230 (100.0)	$\chi^2 = 4.0$ df = 1 p = 0.045
	High	99 (40.4)	146 (59.6)	245 (100.0)	
RBS					
	Normal	165 (46.48)	190 (53.52)	355 (100.0)	$\chi^2 = 5.7$ df = 1 p = 0.017
	High	10 (26.32)	28 (73.68)	38 (100.0)	

Table 2: **Association of physical activity with anthropometric factors and biophysical factors**

		Physical activity		*Total (%)*	*Significance*
		Physically active	*Physically inactive*		
BMI					
	Underweight	38 (84.4)	7 (15.5)	45 (100.0)	
	Normal	182 (74.0)	64 (26.0)	246 (100.0)	$\chi^2 = 5.4$ df = 2 p = 0.068
	Overweight	130 (68.1)	61 (31.9)	191 (100.0)	
WC					
	Normal	154 (76.2)	48 (23.8)	202 (100.0)	$\chi^2 = 2.3$ df = 1 p = 0.130
	High	196 (70.0)	84 (30.0)	280 (100.0)	
WHtR[a]					
	Normal	70 (85.4)	12 (14.6)	82 (100.0)	$\chi^2 = 8.0$ df = 1 p = 0.005
	High	279 (70.1)	119 (29.9)	398 (100.0)	
SBP					
	Normal	126 (80.3)	31 (19.7)	157 (100.0)	$\chi^2 = 6.8$ df = 1 p = 0.009
	High	224 (68.9)	101 (31.1)	325 (100.0)	
DBP					
	Normal	181 (78.0)	51 (22.0)	232 (100.0)	$\chi^2 = 6.6$ df = 1 p = 0.010
	High	169 (67.6)	81 (32.4)	250 (100.0)	
RBS[b]					
	Normal	278 (78.3)	77 (21.7)	355 (100.0)	$\chi^2 = 0.0$ df = 1 p = 0.928
	High	30 (78.9)	8 (21.1)	38 (100.0)	
FBS[c]					
	Normal	32 (53.3)	28 (46.7)	60 (100.0)	$\chi^2 = 1.3$ df = 1 p = 0.257
	High	14 (41.2)	20 (50.8)	34 (100.0)	
Serum cholesterol level[d]					
	Normal	164 (77.0)	49 (23.0)	213 (100.0)	$\chi^2 = 3.7$ df = 1 p = 0.054
	High	181 (69.1)	81 (30.9)	262 (100.0)	

Table 3: **Association of tobacco consumption with anthropometric factors and biophysical factors**

		Tobacco consumption		*Total (%)*	*Significance*
		Yes (%)	*No (%)*		
BMI					
	Underweight	11 (24.4)	34 (75.6)	45 (100.0)	$\chi^2 = 5.7$ df = 2 p = 0.059
	Normal	38 (15.4)	208 (84.6)	246 (100.0)	
	Overweight	21 (11.0)	170 (89.0)	191 (100.0)	
WC					
	Normal	53 (26.2)	149 (73.8)	202 (100.0)	$\chi^2 = 38.4$ df = 1 p < 0.001
	High	17 (6.1)	263 (93.3)	280 (100.0)	
WHtR[a]					
	Normal	18 (22.0)	64 (78.0)	82 (100.0)	$\chi^2 = 4.6$ df = 1 p = 0.032
	High	51 (12.8)	347 (87.2)	398 (100.0)	
SBP					
	Normal	19 (12.1)	138 (87.9)	157 (100.0)	$\chi^2 = 1.1$ df = 1 p = 0.294
	High	51 (15.7)	274 (84.3)	325 (100.0)	
DBP					
	Normal	30 (12.9)	202 (87.1)	232 (100.0)	$\chi^2 = 0.9$ df = 1 p = 0.339
	High	40 (16.0)	210 (84.0)	250 (100.0)	
RBS[b]					
	Normal	43 (12.1)	312 (87.9)	355 (100.0)	$\chi^2 = 0.0$ df = 1 p = 0.928
	High	9 (23.7)	29 (76.3)	38 (100.0)	
FBS[c]					
	Normal	12 (20.0)	48 (80.0)	60 (100.0)	$\chi^2 = 0.1$ df = 1 p = 0.781
	High	6 (17.6)	28 (82.4)	34 (100.0)	
Serum cholesterol level[d]					
	Normal	23 (10.8)	190 (89.2)	213 (100.0)	$\chi^2 = 4.3$ df = 1 p = 0.038
	High	46 (17.6)	216 (82.4)	262 (100.0)	

Missing data – [a] = 2, [b] = 89; [c] = 388; [d] = 7

According to table 3 there was a statistically significant difference between tobacco consumption and WC ($\chi2 = 38.4$, df = 1, $p < 0.001$) and WHtR ($\chi2 = 4.612$, df = 1, p = 0.032). WC and WHtR were significantly higher in participants who did not consume tobacco.

Statistically significant differences were observed between tobacco consumption and RBS ($\chi2 = 4.0$, df = 1, p = 0.045) and serum cholesterol level ($\chi2 = 4.3$, df = 1, p = 0.038). RBS and serum cholesterol levels were significantly higher in participants who did not consume tobacco.

Table 4: **Association of BMI with biophysical factors**

		BMI			*Total (%)*	*Significance*
		Under weight (%)	*Normal (%)*	*Overweight (%)*		
SBP						
	Normal	29 (18.5)	84 (53.5)	44 (28.0)	157 (100.0)	$\chi^2 = 29.0$ df = 2 P<0.001
	High	16 (4.9)	162 (49.8)	147 (45.2)	325 (100.0)	
DBP						
	Normal	31 (13.4)	134 (57.8)	67 (28.9)	232 (100.0)	$\chi^2 = 24.8$ df = 2 P<0.001
	High	14 (5.6)	112 (44.8)	124 (49.6)	250 (100.0)	
RBS[b]						
	Normal	34 (9.6)	183 (51.5)	138 (38.9)	355 (100.0)	$\chi^2 = 1.0$ df = 2 P = 0.607
	High	2 (5.3)	22 (57.9)	14 (36.8)	38 (100.0)	

FBS[c]					
	Normal	7 (11.7)	33 (55.0)	20 (33.3)	60 (100.0)	$\chi^2 = 5.8$ df = 2 P = 0.054
	High	2 (5.9)	12 (35.3)	20 (58.8)	34 (100.0)	
Serum cholesterol level[d]					
	Normal	25 (11.7)	109 (51.2)	79 (37.1)	213 (100.0)	$\chi^2 = 29.0$ df = 2 P = 0.216
	High	19 (7.3)	135 (51.5)	108 (41.2)	262 (100.0)	

Missing data – [a] = 89; [b] = 388; [c] = 7

Table 5: **Association of WC with biophysical factors**

		WC		***Total (%)***	***Significance***
		Normal (%)	***High (%)***		
SBP					
	Normal	76 (48.4)	81 (51.6)	157 (100.0)	$\chi^2 = 4.0$ df = 1 p = 0.044
	High	126 (38.8)	199 (61.2)	325 (100.0)	
DBP					
	Normal	112 (48.3)	120 (51.7)	232 (100.0)	$\chi^2 = 7.4$ df = 1 p = 0.006
	High	90 (36.0)	160 (64.0)	250 (100.0)	
RBS[b]					
	Normal	146 (41.1)	209 (58.9)	355 (100.0)	$\chi^2 = 1.3$ df = 1 p = 0.254
	High	12 (31.6)	26 (68.4)	38 (100.0)	
FBS[c]					
	Normal	34 (56.7)	26 (43.3)	60 (100.0)	$\chi^2 = 2.9$ df = 1 p = 0.086
	High	13 (38.2)	21 (61.8)	34 (100.0)	
Serum cholesterol level[d]					
	Normal	92 (43.2)	121 (56.8)	213 (100.0)	$\chi^2 = 0.2$ df = 1 p = 0.665
	High	108 (41.2)	154 (58.8)	262 (100.0)	

Missing data – [a] = 89; [b] = 388; [c] = 7

According to table 4, there was a statistically significant difference between BMI and SBP (χ^2 =29.0, df = 2, p < 0.001) and DBP (χ^2= 24.8, df = 2, p < 0.001). SBP was significantly higher in participants with normal BMI and DBP was significantly higher in overweight participants.

According to table 5, there was a statistically significant difference between WC and SBP (χ2 = 4.0, df = 1, p = 0.044) and DBP (χ2= 7.4, df = 1, p = 0.006). SBP and DBP were significantly higher in participants with high WC. (Error! Reference source not found.)

Discussion

Association of biophysical factors in predisposition of NCD

A significant association between total cholesterol level and blood pressure (p=0.03) has been found from the research done by H. Kaare [13]. As we assessed the association of serum cholesterol separately with SBP and DBP, our research found a significant association only between serum cholesterol level and DBP (p=0.045).

A large proportion of the participants of our study, with high RBS levels had high serum cholesterol levels too. There was also a statistically significant association between RBS level and serum cholesterol level (0.017) which was also seen in a study done in Lady Reading Hospital, Peshawar (p=0.000) [14].

Association of behavioural factors in predisposition of NCD

A significant association between physical activity and WC has been found from a 30-year longitudinal twin study in Finland (P<0.001) [15]. In contrast, we found that there is no significant association between physical activity and WC (P=0.130). In our study data were more reliable and accurate, as WC was measured by healthcare professionals in HLCs. But in twin study WC was measured by participants themselves which could have cause personal errors.

In our study we found a statistically significant difference between physical activity and SBP (p = 0.009) and DBP (p = 0.010) while a Malaysian population-based study showed SBP level was significantly associated with physical activity level (p = 0.02) whilst no significant association has been noted between physical activity level and DBP (p= 0.31) [16]. One of the plausible explanations for the above difference is, it could be due to the age difference between the two study populations. Our study population was between 30-60 years of age whilst Malaysian study population was all above 16 years of age and also it was found that there was a statistically significant difference between tobacco consumption and RBS (p=0.045) and, we found that majority of adults who have high

RBS levels (76.3%) did not consume tobacco, while only 23.7% of them consumed tobacco.

A community-based, cross-sectional study which was conducted during 2016 in district Nainital, Uttarakhand state, India has found no statistically significant difference between tobacco consumption and FBS levels (p=0.822) [17] which was contradictory to our findings. However, the results of the Indian study could not be generalized as the study was restricted only to elderly subjects (age more than 60 years). Thus, the inability to represent general population was encountered. According to our research we found out that there is a significant statistical difference between tobacco consumption and serum cholesterol levels (p=0.038). Serum cholesterol levels were high in 82.4% of participants who did not use tobacco products & low in 17.6% of participants who used tobacco products. According to a cross sectional study conducted among 1003 elderly people living in district Nainital, Uttarakhand state, India 65.2% of participants who did not use any tobacco products have had high serum cholesterol levels (p=0.039) [17].

So according to our research findings and the compared research findings non consumption of tobacco products does influence the high serum cholesterol levels and high RBS level. In our study we have found that there is a statistically significant difference between tobacco consumption & WC ($p < 0.001$). It was found that majority of adults who have high WC (93.9%) did not consume tobacco, while only 6.1% of them consumed tobacco.

Findings in our research with regards to the association between tobacco consumption & WC coincides with the results of an across-sectional study done in China. According to the research which was done to find out the associations between smoking and obesity in northeast China, there has been a statistically significant difference between tobacco consumption & WC ($p< 0.01$). Also, they have found that, as WC increases, the association between WC and smoking was getting stronger [18].

Association of anthropometric factors in predisposition of NCD

In our study there was a statistically significant association between both BMI and SBP ($p<0.001$) and BMI and DBP ($p<0.001$). Majority of participants with high DBP had high BMI (49.6%).

Another study done by Lady Reading Hospital, Peshawar also reported significant association between BMI and SBP (p=0.000) and BMI and DBP (p=0.000) [14]. Cohort study done in 4 WHO-MONICA centres in UK and France showed significant difference between both SBP and WC ($p<0.0001$) and DBP and WC ($p<0.0001$) [19]. These findings were in accordance with the results of our study (p values - SBP=0.044, DBP=0.006).

Internal validity

The sampling bias was minimized as participants were selected from latest data records depending on their age only. As an interviewer gathered relevant data from participants, non-response bias and self-serving bias got eliminated. Use of anthropometric data measured by health care professionals at HLCs, eliminated self-reporting bias and recall bias which could have result from a self-administered questionnaire. As trained health care professionals interviewed participants, validity and reliability of data were high.

External validity

All participants were selected randomly irrespective of their ethnicity, place of residence, occupation, level of education, comorbidities thus increasing the generalizability.

Limitations

We have collected secondary data from four different HLCs in Kalutara district. Therefore, instruments used to measure the biophysical & anthropometric parameters in each centre may not be exactly the same which can cause an error according to different instruments used for measuring.

Information on behavioural profile was obtained using an oral questionnaire by an interviewer. Sometimes their actual behaviour may differ from their given answers causing an interviewer bias. We have obtained secondary data only from HLCs in Kalutara district. Therefore, the sample may not represent the whole population in the country especially who are in districts with low level of health service facilities.

Conclusions

RBS, serum cholesterol, SBP, DBP, physical activity, tobacco consumption, BMI, WC and WHtR all were significantly associated in predisposition of NCD.

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Conflicts of interest

Authors declare that there is no conflict of interest.

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