AMJ Australasian Medical Journal [AMJ 2024;17(3):1189-1197]

The Impact of Healthy Lifestyle Index on Hypertension among School Going Adolescent Girls: A Cross-Sectional Study

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Research

Please cite this paper as: Rakshit S, Pramanik P. The Impact of Healthy Lifestyle Index on Hypertension among School Going Adolescent Girls: A Cross-Sectional Study. AMJ 2024;17(3):1189-1197.

https://doi.org/10.21767/AMJ.2024.4025

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Abstract

Background

High blood pressure during childhood and adolescence increases the risk of hypertension (HTN) in adulthood. Lifestyle factors including salt consumption, fruits and vegetable consumption, smoking status, alcohol consumption and sleeping duration is associated with blood pressure levels. ‘

Aims and objectives

Thus the aim of our study was to assess the relation between healthy lifestyle index composed of five modifiable lifestyle factors (body mass index, physical activity, fruit intake, extra salt consumption and sleeping duration) and prevalence of HTN among adolescent girls.

Methodology

The present cross sectional study was conducted among female students aged 12-18 years. Height, weight and blood pressure were recorded. Information related to their age, dietary habit including fruit intake and consumption of salt which is added in food items in dining table, daily physical activity and sleeping duration was obtained from self-administered questionnaires. Healthy life style index (HLI) was calculated from 5 modifiable life style factors considering high risk factor as ‘0’ and low risk factor as ‘1’ giving a composite score ranging from 0 to 5. We classified the healthy life style index into three category: 0-2 as low; 3 as medium and 4-5 as high. SBP and/or DBP > 95th percentile in children below 13 years and 130/80 or above in adolescent 13 years or older was considered as HTN. Results are described as mean values + standard deviations (SD). Healthy life style index (low: 0-2; medium: 3; high: 4-5) and risk of HTN were evaluated using logistic regression analysis. The significance level of the tests were considered at a level of 0.05.

Results

18% participants were hypertensive. Significant correlation was obtained between hypertension and all tested life style factors. Magnitude of correlation was higher between HLI and blood pressure than correlation between individual lifestyle factor and blood pressure. Among tested lifestyle factors fruit intake, physical activity and sleeping duration was inversely associated with blood pressure where as direct association was obtained between blood pressure and salt consumption as well as BMI. Considering low HLI as reference group odd ratio significantly low in medium HLI (OR: 13.370; 95% CI: 7.191 to 21.279; p <0.0001) and high HLI (OR: 3.566; 95% CI: 2.288 to 5.558; p <0.0001) groups. Thus risk of hypertension was more among adolescent girls those lead unhealthy life style like BMI > 25kg/m2 or >95th percentile, avoid fruit consumption, consumption of extra salt, insufficient physical activity and inadequate sleeping duration.

Conclusion

Keep away salt from dining table and include fruit item in daily diet should be practiced in everyday life to minimize risk of hypertension. Maintenance of ideal body weight along with sufficient physical activity and adequate sleep is recommended as a healthy habit to minimize the risk of hypertension.

Key Words: Hypertension, table salt, fruit, sleep, healthy life style index

Introduction

Elevated blood pressure or hypertension is a commonest non communicable disease. It is a major contributor to the global burden of disease[1]. The global prevalence of hypertension in adults increased from 594 million in 1975 to 1.13 billion in 2015[2]. The burden of hypertension has shifted from high income countries to low income countries[3]. In children and adolescent HTN is an emerging public health issue as it is asymptomatic in children and adolescence hence remain undiagnosed. Untreated HTN in adolescents persists into adulthood. There is strong evidence of tracking of high BP from childhood to adulthood[4,5]. Thus early detection and intervention for high blood pressure among children and adolescents are gaining importance in recent

years. Life style factors including consumption of fruit and vegetables, overweight and obesity, sedentary life style and smoking are established as risk factors of hypertension[6].

Available evidence suggests a direct relationship between sodium intake and blood pressure levels [7]. The World Health Organization recommended 2.0 gm. per day (corresponding to 5.0 gm. salt) for the general population [8]. Salt intake in India is about 11 g per day, exceeding the WHO's recommended maximum intake[9]. Main source of dietary salt in India is from added salt during cooking or at the table [10, 11].

Fruits are rich in fibers, antioxidant, vitamins (vitamin B, C, E and beta carotene) and minerals (Mg and K) and rarely contain fat, saturated fatty acids, cholesterol and sodium [12]. Fruits are consumed raw as a dessert or a snack and thus have the potential to replace energy-dense snacks [13]. An inverse association between fruit intake and incident of hypertension was reported in previous studies [14, 15]. Meta-analyses [16, 17] as well as cross sectional study reported that short and long sleep duration were associated with higher risk of hypertension. While several studies reported that only short duration sleep is associated with an increased risk of hypertension [18-20].

Moderate to vigorous intensity physical activity associated with lower incidence of HTN among white men [21]. Yet a large cross-sectional study demonstrated an inverse relationship between daily engagement in physical activity and odds of being hypertensive in youth ages 8-17 [22]. 1-2 hour daily habitual physical activity (outdoor game/walking/bicycle riding) significantly decreases odd ratio as well as risk of HTN among adolescent boys [23].

Among the modifiable risk factors with incident of hypertension excessive body weight is one of the highest attributable risks like cigarette smoking. Epidemiological studies suggested that overweight predicts future development of HT and there is linear relationship between BP and BMI [24]. Prevalence of elevated blood pressure is higher in overweight and obese children in compare to non-overweight and non-obese children [25, 26]. According to WHO 70 million children will be overweight and obese by 2025 [27]. In India prevalence of childhood and adolescent obesity varies from 3% to 29% [28].

To date, there was increasing evidence that lifestyle factors play an important role in the development of hypertension [29]. Hypertension can be prevented by insisting on a healthy lifestyle like regular exercise, keeping weight under control avoiding smoking and so on [30]. Despite evidence that individual lifestyle behaviours influence prevalence of hypertension, combined effect of multiple lifestyle behaviours score may better reflect the correlation between risk factors and hypertension [31]. Thus the present study was undertaken to evaluate the association between healthy lifestyle index composed of modifiable five life style factors (body mass index, physical activity, fruit intake, extra salt consumption and sleeping duration) and incident of HTN among adolescent girls of West Bengal, India. As a secondary objective this study explore the independent association between each HLI component and risk of hypertension.

Methodology

Study population

The present study was conducted among adolescent students having age limit 12-18 years from five schools in West Bengal, India during their school hours. The prior written permission of school authority was taken. Written consent from the parents of students experimented in the study was obtained. 799 female students were included in this study.,Students having age less than 12 years or more than 18 years, sex other than female, those who were taking regular drugs or hormonal therapy and suffering from chronic disorders including diabetes mellitus, clinically established hypertension, liver cirrhosis and kidney disease were excluded from the study.

Questionnaire

A self-administered questionnaire having questions related to their age, dietary habit including fruit intake and consumption of salt which is added in food items in dining table, physical activities and sleeping duration. Besides these family history regarding diabetes, kidney disease, congenital heart defect, myocardial infarction and/or stroke also recorded.

Measurement of blood pressure

Blood pressure was measured using digital oscillometric blood pressure monitor. Before recording the blood pressure students were allowed to wait for 10 minutes in a sitting positions to relieve their restlessness and anxiety [32]. Two readings were taken at 2 minute intervals and their mean was taken as subject's blood pressure. In the case when the differences of two readings were above 5mmHg a third reading was taken. The final reading would be the based on the average of all readings taken. Normotensive, elevated blood pressure and hypertension was define on the basis of American Academy of Paediatrics Guideline-2017 [33]. In adolescent aged 12 years systolic blood pressure (SBP) and/or diastolic blood pressure (DBP) > 90th percentile but < 95th percentile or 120/80 (whichever is lower) is considered as elevated blood pressure and SBP and/or DBP > 95th percentile plus 12 mm Hg or 130/80 (whichever is lower) as hypertension. In adolescent 13 years and older SBP and/or DBP 120/<80 to 129/<80 is considered as elevated blood pressure and 130/80 or above as hypertension.

Anthropometric measurements

Body weight was measured using digital weighing scale accurate to 0.5kg with participants wearing light clothes and no shoes. .For the measurement of height subjects were asked to stand still and quiet and erect position, hanging their arms freely and keeping their head aligned in the Frankfort plane. The measurements were recorded to the

nearest 0.1 cm for each subject using anthropometric rod [34]. BMI was calculated from the height and weight using following equation: BMI (kg/m2) = weight (kg) / height2 (m). BMI was calculated from the height and weight using following equation: BMI (kg/m2) = weight (kg) / height2 (m).

Construction of healthy lifestyle index

Information on five modifiable lifestyle factors namely body mass index, physical activity, fruit intake, extra salt consumption and sleeping duration was used to construct the HLI (Table 1). Based on previous reports and recommendations we dichotomized each lifestyle factor into a law-risk and high risk group. Low and high risk groups given scores 1 and zero respectively. Summation of scores indicates HLI [35]. We classify HLI into three category: low (score 0-2), medium (score 3) and high (score 4-5).We defined the low-risk BMI as participant with BMI < 25kg/m2 22 and low risk physical activity participants who engaged in > 60 min/day in habitual physical activities like walking, bicycle riding and outdoor playing 23 and sleep duration > 7h/nightwas consider as low risk group [36]. We defined the low-risk group for fruit consumption as participant consuming fruit one serving every day or at least > 2 serving for 3 days/ week and low risk for salt intake who avoid salt in dining table.

Statistical analysis

Frequencies and means of the participants' characteristics in respective to blood pressure status were calculated. Differences in the characteristics between hypertensive and non-hypertensive group were estimated using t-test. Correlation between lifestyle parameters as well as HLI with blood pressure status was evaluated. Logistic regression analysis were done to examine the association between lifestyle factors and hypertension. We calculated odd ratios and corresponding 95% confidence of hypertension for HLI and lifestyle factors. Statistical significance was determine at p value <0.05.

Results

799 adolescent school girls were included in this analysis. All the participants were non-smoker and unmarried. Among the participants 18.27% were hypertensive. Physical and lifestyle characteristics of hypertensive and non-hypertensive group of girls were given in (Table 2).There was significant difference of BMI, sleeping duration and daily physical activity among hypertensive and non-hypertensive group. Prevalence of fruit intake is more in non-hypertensive group in compare to hypertensive counterpart. However, prevalence of intake of table salt is more among hypertensive group than non-hypertensive group.

Table-3 represents the distribution of study population on the basis of lifestyle factors and HLI. Prevalence of overweight and obesity, salt intake and inadequate sleep was higher among hypertensive group than non-hypertensive counterpart. However, prevalence of fruit intake and average daily physical activity was lower than non-hypertensive group. In hypertensive group prevalence of low and medium HLI was more whereas high HLI was less than non-hypertensive counterpart.

Correlation between five modifiable lifestyle factors and BP level of adolescent's girls was represented in (Table-4). There is significant correlation between all tested lifestyle factors with hypertension. There was negative correlation of fruit consumption and involved in physical activities daily one hour or more with hypertension. Positive correlation was noted between hypertension with intake extra salt, inadequate sleeping duration and BMI.

Logistic regression analysis was done to evaluate association between hypertension (dependent variable) and five modifiable lifestyle factors (independent variables). Results suggested significant inverse association of fruit consumption, physical activity (at-least 60 min/day) and sleeping duration (> 7 h/night) with hypertension. This study also suggested significant direct association of higher BMI (> 25.00 kg.m2) and intake of extra salt with hypertension. Odd ratio suggested that BMI and table salt intake increase the risk of hypertension. On the other hand fruit consumption, adequate sleep (>7h/night) and involved in physical activities decrease the risk of hypertension (Table 5).

Correlation between blood pressure status and lifestyle factors with HLI was represented in (Table-6). Significant negative correlation was noted between HLI and blood pressure level.

Bivariate analysis was done to evaluate the risk of hypertension and HLI. Considering low HLI as reference odd ratio was less in middle and high HLI group (Table 7). This result suggested that risk of hypertension was least among high HLI group.

Discussion

This study showed that HLI was associated with lower prevalence of hypertension. This association was stronger for HLI than individual components suggesting that there may be a synergistic effect among risk factors. Our results coincide with previous observations [36, 37].

Lifestyle factors used to construct HLI vary across studies. BMI, physical activity, smoking status and alcohol consumption are frequently employed [38,39] .Whereas other factors like sleep duration 36 waist-hip ratio, psychological distress 41, and cardiorespiratory fitness 39 are used only occasionally. Several studies have incorporated dietary component like fruit and vegetable consumption and intake of comprehensive diet to stop hypertension [40,41]. We have evaluated the impact of HLI using established risk factor BMI, dietary intake and two emerging risk factors viz. sleep duration and duration of habitual physical activity on prevalence of hypertension.

Among the modifiable risk factors with incident of hypertension excessive body weight is one of the highest

attributable risks like cigarette smoking. Prevalence of smoker among girls is insignificant. In our study we selected girls those are non-smoker. Excessive bodyweight has been on the rise worldwide including our country. Recent studies in India reported that prevalence of overweight varies from 17%- 18% and obesity from 6% -7% among Indian adolescent aged 10-19 years [42, 43].Adolescent overweight and obesity is a global health issue as a risk factor for non-communicable diseases including diabetes mellitus and cardiovascular diseases. Thus in our study we selected BMI as a modifiable lifestyle factor.

Prolonged sleep insufficiency is associated with non-communicable diseases like diabetes mellitus, hypertension and heart attack [44]. More than 50% secondary school children and adolescents from Mumbai city suffer in sleep deprivation from television watching, extensive use of media like computer and cell phone and remained worried about the next day [45]. Some individual suffer in sleep deprivation from academic pressure and examinations [46].Hence we selected sleep duration as lifestyle factor.

High salt intake is associated with high blood pressure in children [47]. Excessive salt intake elevates blood pressure and salt reduction lowers blood pressure in hypertensive and normotensive subjects [48]. Salt intake in India is about 11 g per day, exceeding the WHO's recommended maximum intake, 5 gm/day 9. Main source of dietary salt in India is from added salt during cooking. Thus intake of added salt at the table was considered as a modifiable lifestyle factor.

Fruit intake is beneficial in preventing hypertension [49]. Among Indian adolescent consumption of milk or milk products, green leafy vegetable and fruit far less than who recommended level [50]. Fruits are rich in dietary fibers, antioxidants, potassium and magnesium all of which could have beneficial effects on the prevention of hypertension [51, 52]. Thus in this study we consider fruit consumption as a modifiable life style factor.

Hypertension and prehypertension were positively correlated with less physical activity level in children and adolescents[53].In recent decades, children have become increasingly sedentary with low level of physical activity which enhances the risk of hypertension [54]. Thus physical activity is a healthy style factor and considered as a component for computation of HLI.

To the best of our knowledge this is the first study that focuses on the association of HLI with hypertension in adolescent Indian girls. This study showed that higher HLI was associated with a reduced risk of hypertension. Our findings support the evaluation of multiple lifestyle factors in relation to health outcomes. The design of interventions that target multiple lifestyle factors and shared drivers of these factors is likely to be an effective and efficient public health strategy.

Conclusion

We have observed that there was a significant correlation between HLI and its components with hypertension. But the association was stronger for HLI than individual components suggesting that there may be a synergistic effect among risk factors. The present study also showed that prevalence of hypertension was lower in individual who had physically active, maintained recommended body weight, consumed fruits regularly, never added extra salt in food items in dining table and got adequate sleep. On the basis of our finding, we concluded that greater adherence to healthy lifestyle as assessed by higher HLI score, is associated with a reduced risk of hypertension in adolescent girls.Thus adherence of these healthy lifestyle recommendations is likely to be beneficial to minimize medical and financial burden for hypertension.

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CONSENT

The study was non-invasive. The prior written permission of the Institutional authority was taken. The written informed consent was obtained from the study participants and their parent after the purpose of the study was explained. Participants were informed that the data obtained from them would be kept confidential.

ETHICAL APPROVAL

Written ethical approval has been collected and preserved by the author(s).

ACKNOWLEDGEMENTS

Authors thankfully acknowledge the cooperation rendered by school authorities and students. The authors thank all participants for giving the time to complete the questionnaire. Their kind cooperation in this investigation is highly cherished from the core of our heart. The authors deeply appreciate Dr. Shyam Sundar pal, Assistant Professor of Economics, for his valuable help for statistical analysis.

CONFLICTS OF INTEREST

Both authors declared that they have no conflict of interests and no competing interests regarding this work.

FUNDING:

This work received no specific grant from any funding agency in the public, commercial or not-for profit sectors.

Tables

Table-1: Components for healthy life style index

Healthy life style index components	**Low risk group (score=1)**	**High risk group (score=0)**
BMI	Below 25 Kg/m^2 or below 95th percentile	$\geq$ 25 Kg/m^2 or $\geq$ 95th percentile
Physical activity	$\geq$ 60 min/day	< 60 min/day
Sleeping duration	$\geq$ 7 hour/night	< 7hour/night
Fruit consumption	$\geq$ 7 serving / week	No or intake with low frequency
Intake table salt	No	Yes

Table-2: Comparison of lifestyle characteristics of non-hypertensive hypertensive group

Characteristics	Non-hypertensive group	Hypertensive group
Number of participant	653 (81.73%)	146 (18.27%)
BMI (kg/m^2)	19.88 $\pm$ 4.26	21.80 $\pm$ 4.48*
Sleeping duration (h/night)	7.85 $\pm$ 1.38	7.18 $\pm$ 1.35*
Physical activities (h/day)	133.40$\pm$46.63	108.84 $\pm$ 38.90*
Regular fruit consumption	504 (77.18%)	61 (41.78%)
Intake of extra salt	199 (30.47%)	69 (47.26%)

Table-3: Distribution of study population on the basis of lifestyle factors and HLI

Lifestyle factors and index		Total participants	Non-hypertensive	Hypertensive
BMI (kg/m2)	< 25.00	681	575 (84.44%)	106 (15.56%)
	$\geq$ 25.00	118	78 (64.39%)	40 (35.61%)
Physical activity (h/day)	<1	88	58 (65.91%)	30 (34.09%)
	$\geq$1	711	595 (83.69%)	116 (16.31%)
Fruit intake	Yes	565	506 (89.56%)	59 (10.44%)
	No	234	147 (62.82%)	87 (37.18%)

Table salt intake	Yes	268	192 (71.64%)	76 (28.36%)
	No	531	461 (86.82%)	70 (13.18%)
Sleep (h/night)	<7	153	103 (67.32%)	50 (32.68%)
	≥7	646	550 (85.14%)	96 (14.86%)
HLI	Low (0-2)	71	29 (40.85%)	42 (59.15%)
	Medium (3)	146	102 (69.86%)	44 (30.14%)
	High (4-5)	582	522 (89.69%)	60 (10.31%)
	Highest (5)	244	238 (97.54%)	6 (2.46%)

Table-4: Covariance Analysis: assessment of correlation between blood pressure level and lifestyle factors

Correlation Probability		Blood pressure	BMI	Fruit consumption	Physical activity	Extra salt intake	Sleeping duration
Blood pressure	r	1.000000					
	p	-----					
BMI	r	0.184731	1.000000				
	p	0.0000	-----				
Fruit consumption	r	-0.297749	-0.049935	1.000000			
	p	0.0000	0.1585	--------			
Physical activity	r	-0.147767	-0.071700	-0.010529	1.000000		
	p	0.0000	0.0427	0.7663	--------		
Extra salt intake	r	0.141573	0.040500	-0.008807	-0.026977	1.000000	
	p	0.0001	0.2528	0.8037	0.4464	-----	
Sleeping duration	r	-0.189574	-0.013949	0.094487	0.068315	-0.060895	1.000000
	p	0.0000	0.6938	0.0075	0.0536	0.0854	-----

Table-5: Logistic regression model for association between healthy lifestyle index components and hypertension

Independent variable	Coefficient	Std Error	Z-statistics	Odd ratio	Prob
BMI (Kg/m^2) [< 25.00=0; ≥ 25.00=1]	1.0775	0.2453	4.3932	2.9373	0.0000
Fruit intake(Yes=1, No=0)	-1.5663	0.2050	-7.6389	0.2088	0.0000
Table salt intake (Yes=1, No=0)	0.6992	0.2815	3.3863	2.0121	0.0007
Physical activity(min/day) [< 60 min=0; ≥ 60min=1]	-0.0321	0.2065	-3.5994	0.3631	0.0003
Sleep (h/night) [<7h = 0; ≥ 7hr=1]	-0.9221	0.2273	-4.0567	0.3977	0.0000
Dependent variable: blood pressure (consider non-hypertensive as 0 and hypertension as 1)					

Table-6: Correlation between HLI with blood pressure and life style factors

	Correlation coefficient	Probability
BMI (Kg/m^2) [< 25.00=0;≥ 25.00=1]	-0.4384	0.0000
Fruit intake(Yes=1, No=0)	0.5276	0.0000
Table salt intake (Yes=1, No=0)	-0.5400	0.0000
Physical activity(h/day) [< 1.0 =0; ≥ 1.0 =1]	0.3823	0.0000
Sleep (h/night) [7h = 0; ≥ 7h=1]	0.5066	0.0000
BP level (Non-Htn=0; Htn=1)	-0.4009	0.0000

Table-7: Bivariate regression analysis of hypertension according to healthy lifestyle index categories

HLI	Non-hypertension	Hypertension	Odd ratio	95% CI	p
0-2	29	42	1.00 (Ref)	------	-----
3	102	44	0.2979	0.1650 to 0.5377	0.0001
4	284	54	0.1313	0.0753 to 0.2288	<0.0001
5	238	06	0.0174	0.0068 to 0.0445	<0.0001

Received: *20-Feb-2024, Manuscript No. AMJ-24-4025;* ***Editor assigned:*** *23-Feb-2024, PreQC No. AMJ-24-4025(PQ);* ***Reviewed:*** *08-Mar-2023, QC No. AMJ-24-4025;* ***Revised:*** *13-Mar-2024, Manuscript No. AMJ-24-4025(R);* ***Published:*** *20-Mar-2024*