Influence of Active Travel to School on the Blood Pressure of In-School Children and Adolescents in Benue North West Senatorial District, Benue State

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Abstract

This study examined the influence of active travel to school (ATS) on the blood pressure of in-school children and adolescents in Benue North West Senatorial District of Benue State. An ex-post facto design was adopted for the study. The study sample comprised 663 in-school children and adolescents, aged 10-18 years, who were recruited using a multi-stage sampling technique and evaluated. A self-structured questionnaire was used to obtain participants' mode of travel. Subjects' blood pressure was measured by auscultation method using a stethoscope and sphygmomanometer and by the protocol of the Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents by the National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents. One-way Analysis of variance (ANOVA) was used to test the hypotheses at 0.05 alpha level. The study revealed that ATS does not significantly influence systolic blood pressure (SBP) and diastolic blood pressure (DBP) ($p= 0.05$) respectively in children and adolescents in Benue North West Senatorial District of Benue State. It was therefore recommended that efforts to lower blood pressure in this population should not depend solely on advocating for ATS. Instead, a broader strategy such as taking a balanced diet, promoting games and sports beyond ATS, and having periodic health check-ups are necessary for public health.

Keywords: Active travel, Blood pressure, Coronary heart disease

Introduction

The prevalence of non-communicable diseases (NCDs) remains a societal burden. The World Health Organisation (WHO, 2021) estimates that cardiovascular diseases (CVDs) alone cause 17.9 million NCD deaths per year, or 31% of all fatalities worldwide, with 75% of these deaths taking place in low- and middle-income countries [LMICs] (WHO, 2017). The "rapid, unplanned, and unmanaged" urbanisation (Juma et al., 2019) that is typically associated with an increase in CVD risk factors like dietary changes, sedentary lifestyles, obesity, tobacco use, and exposure to air pollutants may have contributed to the rise in NCDs observed in LMICs, including Africa (Pirgon & Aslan, 2015; Juma et al., 2019). These factors are interwoven with the socio-economic transitions in LMICs, further worsening the public health challenges related to NCDs, including coronary heart diseases, in these regions.

Coronary heart disease (CHD) is a subset of cardiovascular diseases (CVDs). The pathologic process of atherosclerosis, or the accumulation of fatty deposits in the coronary arteries, is what defines CHD, commonly referred to as coronary artery disease (CAD)

(Genders & Hunink, 2012; King et al., 2020). According to Genders and Hunink (2012), CHD encompasses a variety of clinical diagnoses, such as angina pectoris, acute myocardial infarction, and other types of acute and chronic ischaemic heart disease.

Children are also susceptible to the traits, environmental conditions, or lifestyle choices that make them more likely to develop CHD. For instance, epidemiological research has shown that children share risk factors for CHD with adults, including family history, high blood cholesterol, obesity, hypertension, and insufficient physical activity (Falkstedt & Hemmingsson, 2011; Abrignani et al., 2019). These studies highlight how crucial lifestyle changes and early detection are to reducing these risks and enhancing cardiovascular health, particularly managing high blood pressure early in life.

One of the risk factors for CHD is high blood pressure, also known as hypertension (HTN), which has been identified as the leading cause of death and disability globally. The World Health Organisation (2021) revealed that people who have high blood pressure (BP) as children are more likely to have hypertension (HTN) as adults (Yang et al., 2020; Azegami et al., 2021), and that hypertension in childhood and adolescence is strongly linked to future target organ injuries like ventricular hypertrophy, coronary artery calcification, and increased carotid intima-media thickness (Flynn et al., 2017; Li et al., 2021). Early beginning of HTN has been linked in several studies to a longer treatment cycle, more difficult blood pressure control, and a worse prognosis (Yang et al., 2020; Wang et al., 2020).

Hypertension (HTN) is sometimes referred to as the "silent killer" because, even in cases where blood pressure is dangerously high, it frequently exhibits no symptoms, making many people unaware of their illness. In addition to adults, the normative distribution of blood pressure in healthy children serves as the basis for the definition of hypertension in children and adolescents. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) below the 90th percentile for height, age, and sex are considered normal blood pressure. Average SBP and/or DBP that exceeds or equals the 95th percentile for height, age, and sex three or more times is referred to be hypertension. Likewise, a mean SBP or DBP value that exceeds or is equivalent to the 90th percentile but falls below

According to a systematic review and meta-analysis conducted worldwide, the pooled prevalence of hypertension among children and adolescents aged 19 years and under was 4.0% based on three different visits (Song et al., 2019). According to a systematic study and meta-analysis by Crouch et al. (2022), the prevalence of paediatric hypertension in Africa has risen to 7.45%, a 36% increase from earlier estimates. Furthermore, it has been observed that a high prevalence rate of roughly one in ten teenagers in sub-Saharan Africa has HTN (Gouda et al., 2019). According to these reports, there is an urgent need to enhance regional blood pressure monitoring and other preventative heart health initiatives (Kwan et al., 2016). In Nigeria, Ejike (2017) conducted a systematic review and trend analysis of data from January 1978 to May 2016, finding a prevalence of 8.2% for prehypertension and 5.1% for HTN in Nigerian children and adolescents over the past four decades. Although the prevalence rate of HTN is low when compared with global and regional rates, this finding highlights the need for interventions to address CHD risk factors in children and adolescents in the region.

The relationship between regular physical activity and health has long been recognized, with a foundational scientific link identified in Jerry Morris' groundbreaking research involving London bus drivers during the 1950s (Morris et al.,1953). This highlights how important exercise is for general health. While active travel is free, habitual, and typically required in daily life, leisure activities like going to the gym can be costly and hard to maintain over time. Therefore, promoting "active travel" could be a simple and practical way to boost physical activity levels (de Nazelle et al., 2011). It can be inferred that a school-based program designed to promote habitual and economical physical activity in children, like active travel, may not

only improve and promote physical fitness but specifically have a positive impact on blood pressure and overall health.

Active travel to school (ATS) is a non-polluting form of transport, free of charge, which allows greater contact with the environment and can be conveniently incorporated into the routine of school-age children and adolescents (Page et al., 2010). Gerrard (2011) defined ATS as a form of transport that includes walking, cycling, or other forms of non-motorized transportation. Regarding its benefits, Larouche et al. (2014) averred that ATS is a potential strategy to increase physical activity levels and potentially reduce CHD risk factors in young people.

On the beneficial effect of ATS on blood pressure, Millett et al. (2013) reported a significant association between bicycling to work and lower rates of hypertension among Indian adults, suggesting a protective effect of ATS on hypertension. The study's emphasis on adult business travel, however, could not be directly applicable to children's or adolescents' school travel situations. Furthermore, causal inference is limited by the cross-sectional design. Apart from the positive impact of ATS, Furie and Desai (2012) found that active travel is linked to better coronary risk factor profiles, which further supports the infrastructure and regulations that support and promote it. Although the literature is replete with the benefits of ATS on several health outcomes, it does not directly address the direct relationship between active travel to school and blood pressure among children and adolescents. Additionally, the existing studies focus more on health outcomes and factors associated with active travel to school, such as physical activity levels, cardiovascular fitness, body mass index (BMI), and subjective health measures. For instance, Cooper, et al. (2006) reported that children and adolescents who cycled to school were significantly more fit than those who used other modes of travel, which could suggest a potential effect on blood pressure, although it is not explicitly stated. Also, Henriques-Netoet et al. (2020) reported that ATS modes are an important source of daily energy expenditure, helping young people to improve their physical fitness. Similarly, Ding et al. (2023) found that bicycling to school positively affects both subjective and physical health, including healthier weight and lower levels of mental stress, but does not mention hypertension specifically.

It is interesting to note that while Lubans et al. (2011), Østergaard et al. (2012), DeWeese and Ohri-Vachaspati (2015), Sarmiento et al. (2015), Sternfeld et al. (2017), Sareban et al. (2020), and Wex Geserick et al. (2023) investigated body mass index (BMI) and the likelihood of being overweight or obese which are risk factors for hypertension, they did not specifically look at HTN. It appears that this particular health outcome has not been a primary focus of research in this population because there is no direct evidence in the literature about the effect of ATS on hypertension. The general health advantages and risk factors for hypertension stated, such as reduced BMI and increased cardiovascular fitness, could be used to infer a possible link between active travel and HTN (Cooper et al., 2006; Østergaard et al., 2012). However, any conclusions would be theoretical in the absence of clear empirical information regarding this particular consequence. Therefore, more study is required to clearly examine and conclusively demonstrate how active school travel affects hypertension in this population.

Furthermore, ATS's prevalence has drastically decreased worldwide, despite its possible advantages. The percentage of teenagers in the Czech Republic who walked or rode their bikes to school dropped from 74.3% in 2006 to 53.4% in 2014 (Pavelka et al., 2017). According to Coll et al. (2014), active commuting among adolescents in Brazil fell from 69% in 2005 to 56.5% in 2012, while among youngsters, it reduced by 17% during a five-year period (Costa et al., 2012). Higher socioeconomic class schools and metropolitan regions in Africa have lower ATS rates, according to Larouche et al. (2014). Although there isn't any concrete

proof of a drop in Nigeria, obstacles such a lack of pedestrian amenities and rising car ownership (Olojede et al., 2017) point to potential problems in the future. Because of urbanisation and technological breakthroughs, which are linked to the progression of CHD, motorised transportation has supplanted walking and bicycling to schools in the Benue North West Senatorial District. The World Heart Federation's Vision 2030, which aims to reduce cardiovascular mortality and incidence by at least 30%, is in line with achieving Sustainable Development Goal 3.4, which is to reduce premature mortality from NCDs by one-third by 2025 (WHF, 2023). Although there is little data on how ATS directly impacts children's blood pressure and other CHD risk factors, especially in the Benue North West Senatorial District, promoting ATS may help lower paediatric hypertension. Therefore, this study assessed the influence of active travel to school on the blood pressure of in-school children and adolescents in this region. Specifically, the study determined the influence of active travel to school on systolic blood pressure and diastolic blood pressure among children and adolescents in Zone B Senatorial District of Benue State.

Materials and Methods

This study used an ex-post facto research design. Benue North-West Senatorial District, also referred to as Zone "B," in Benue State, Nigeria, was the study's location. Buruku, Tarka, Guma, Makurdi, Gwer, and Gwer West are the seven local government areas that make up the senatorial district. There are 48,157 pupils enrolled in the region's 87 public and grant-in-aid secondary schools (Benue State Ministry of Education, 2023).

A total of 700 participants were selected for this study using a multi-stage sampling procedure. Four Local Government Areas (LGAs) were chosen from Benue State's Zone B Senatorial District in the first stage using systematic random sampling. Four secondary schools were purposively chosen from each drawn LGA in the second stage, giving a total of 16 schools. In the third stage, 75 students from each of the schools were drawn using simple random sampling technique of balloting without replacement.. Only 663 of the 700 volunteers who were initially enrolled finished the trial since some were disqualified for absenteeism and white coat syndrome. Krejcie and Morgan's (1970) formula was used to calculate the sample size.

Blood Pressure Measurement

The research and ethics committee of Benue State University Teaching Hospital, Makurdi, granted ethical clearance prior to the study's start. After obtaining the necessary consent from the school administrators, the participants were informed of the study's goal and methodology. Prior to their involvement in the study, subjects completed the Physical Activity Readiness Questionnaire (PAR-Q), as advised by the human subject protocol, and the principals of the schools signed written informed permission on behalf of the subjects and their parents.

The National High Blood Pressure Education Program (NHBPEP) Working Group on High Blood Pressure in Children and Adolescents (NHBPEP/HBPCA) Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents (2004) provided the protocol used to measure blood pressure (BP). In order to accurately diagnose and treat high blood pressure in children and adolescents, the procedure places a strong emphasis on the use of appropriate equipment, proper technique, and multiple measurements. Using a stethoscope and a sphygmomanometer (Adscope 600; ADC Hauppauge, New York, USA), the auscultation method was used to assess the patients' blood pressure. These are gold standard instruments certified by NHBPEPWG/HBPCA for the measurement of BP in children and adolescents. Measurements were conducted in the morning

between 8:00 AM and 10:00 AM to minimise the effects of circadian variations in blood pressure. Subjects were seated quietly in a room for at least 5 minutes, with their backs supported and feet resting comfortably on the floor. The right arm was positioned on the table at heart level for precision, and a cuff covering 80-100% of the arm circumference was wrapped snugly on the upper arm, 2-3 cm above the antecubital fossa. The cuff was inflated to 20-30 mmHg using the dial of the sphygmomanometer, above the point where the radial pulse disappeared, and then deflated at 2-3 mmHg per second. The stethoscope was used to listen to the sounds. The first Korotkoff sound indicated systolic pressure (SBP), and the fifth sound (disappearance) indicated diastolic pressure (DBP). Three measurements were taken at 5-minute intervals, and the averages of the systolic and diastolic readings were recorded as the mean SBP and DBP. The average of three measurements was taken to take care of natural changes in blood pressure and to provide more accurate readings. Two trial versions of the measurements were conducted on thirty students in the Human Performance Laboratory, Department of Human Kinetics and Health Education, at Benue State University, Makurdi, before the actual data collection.

Measurement of Mode of Travel

Participants' modes of transportation were gathered via a self-structured questionnaire. Data were collected with the aid of four research assistants who were final year students of Human Kinetics and Health Education, Benue State University, Makurdi.

Data Analysis

In order to assess the influence of ATS on BP, a CHD risk factor, the sample was divided into three groups: bus/motorbike users, cyclists, and walkers. One-way ANOVA tested the hypotheses at a 0.05 significance level. Significant f-ratios were followed by Scheffe post-hoc tests to pinpoint differences. All analyses were conducted using SPSS for Windows, version 21.0.

Results

Table 1
Anthropometric and Physiological Characteristics of the Participants (n=663)

Variable	Mean	S.D
Age (years)	14.7	4.8
Height (cm)	157.9	40.5
Weight (kg)	49.4	11.4
SBP (mmHg)	103.9	52.4
DBP (mmHg)	64.3	26.9
Mile Run Walk (MRW) (minutes & sec.)	10.9	2.4
Body Mass Index (BMI) (kg/m^2)	20.0	3.9

Data in table 1 showed the mean age distribution of participants as 14.7 with a standard deviation of 4.8. The participants also had a mean distribution of 157.9 with a standard deviation of 40.5 for height. The mean body weight was shown to be 49.4 with a standard deviation of 11.4. With regards to SBP (mmHg), the mean stood at 103.9 while the standard deviation stood at 52.4. The mean DBP (mmHg) was shown to be 64.3 with a standard deviation of 26.9. The mean MRW time was shown to be 10.9 with a standard deviation of 2.4, while the mean distribution for BMI was 20.0 with a standard deviation of 3.9.

Table 2

One-way ANOVA on the Influence of Active Travel to School on SBP of Participants (n=663)

Source of Variation	Sum of Squares	Df	Mean of Squares	F-ratio	Sig.
Between Groups	4490.540	2	2245.270	.817	.442
Within Groups	18125856.6	660	2746.752		
Total	1817347.1	662			

F-ratio =.817, df (2; 660), p> 0.05.

Data in table 2 showed that active travel to school does not significantly influence SBP among children and adolescents in Zone B Senatorial District of Benue State (F = 0.817, df (2; 660), p = .442> 0.05).

Table 3

One-way ANOVA on the Influence of Active Travel to School on DBP of Participants (n=663)

Source of Variation	Sum of Squares	Df	Mean of Squares	F-ratio	Sig.
Between Groups	825.731	2	412.865	.567	.567
Within Groups	480378.48	660	727.846		
Total	481204.21	662			

F-ratio =.567, df (2; 660), p> 0.05.

Data in table 3 showed that active travel to school does not significantly influence DBP among children and adolescents in Zone B Senatorial District of Benue State (F = .567, df (2; 660), p = .567> 0.05).

Discussion

The results of this study indicated that active travel to school (ATS) does not have a significant influence on systolic blood pressure (SBP) or diastolic blood pressure (DBP) in the children and adolescents studied. These results align with previous research. For instance, Villa-González et al. (2015) found no significant associations between active commuting to school and cardiorespiratory fitness, including blood pressure. Similarly, Zhang et al. (2020) reported no significant differences in SBP and DBP between active and passive school travelers. However, these findings are at variance with those of Lee et al. (2008), whose systematic review noted a consistent association between active commuting and increased total physical activity, but the evidence for an association with reduced blood pressure or body mass index was inconclusive. In addition, Santana et al. (2017) found that active commuting was a protective factor against high blood pressure in adolescents living in rural areas. The mixed results on the link between ATS and blood pressure in children may result from differences in study populations, ATS conceptualization, BP measurement methods, physical activity adherence and study designs, along with the influence of various environmental factors. The mixed results across studies such as the present one suggest that the influence of ATS on blood pressure in children calls for further research.

Conclusion

Based on the results obtained, it was concluded that ATS does not significantly influence blood pressure in children and adolescents in Benue North West Senatorial District

of Benue State. This implies that although ATS can confer several health advantages, including enhanced physical fitness and decreased body fat, it might not be enough by itself to effectively influence blood pressure in the paediatric population. Based on this finding, efforts to lower blood pressure in this population should not depend solely on advocating for ATS. Instead, a broader strategy such as taking a balanced diet, promoting games and sports beyond ATS, and having periodic health check-ups are necessary for public health. Additional research should investigate other elements that contribute to hypertension and evaluate the long-term effects of ATS when paired with other lifestyle changes.

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