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ORIGINAL ARTICLE

Screening for Hypertension in Obese Adolescents using Ambulatory Blood Pressure Monitoring

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ABSTRACT

Background: Obesity in adolescents is associated with an increased risk of hypertension, which may remain undiagnosed using conventional office blood pressure (OBP) measurements. Ambulatory blood pressure monitoring (ABPM) provides a comprehensive assessment of blood pressure patterns over 24 hours, capturing daytime and nighttime variations, and identifying masked or white coat hypertension.

Objective: To evaluate the effectiveness of ABPM in screening for hypertension among obese adolescents in a tertiary care hospital.

Methods: A cross-sectional study was conducted at the Department of Cardiology Medical Teaching Institution Bannu, Department of Cardiology DHQ Teaching Hospital MTI DI Khan, department of pediatrics Medical Teaching Institution, Bannu and Department of Medicine Pak International Medical College Peshawar, from September 2021- Feb 2022, enrolling 100 obese adolescents aged 12–18 years. Baseline demographic data and body mass index (BMI) were recorded. Office blood pressure measurements were taken using a standardized protocol, followed by 24-hour ABPM. Blood pressure readings were analyzed for average daytime, nighttime, and 24-hour values, nocturnal dipping status, and prevalence of masked or white coat hypertension. Data were analyzed using SPSS, with $p<0.05$ considered statistically significant.

Results: Among participants, 18% had elevated office blood pressure, while ABPM detected hypertension in 30%. Masked hypertension and white coat hypertension were observed in 8% and 5% of participants, respectively. Non-dipping nocturnal patterns were identified in 20% of adolescents. Male participants had slightly higher prevalence of hypertension compared to females (32.8% vs. 26.2%), though this was not statistically significant. ABPM revealed blood pressure patterns not captured by office measurements, emphasizing its diagnostic superiority.

Conclusion: ABPM is an effective tool for detecting hypertension and abnormal blood pressure patterns in obese adolescents. Routine use of ABPM can facilitate early identification and intervention, reducing long-term cardiovascular risk.

Keywords: Obesity, Adolescents, Hypertension, Ambulatory Blood Pressure Monitoring

INTRODUCTION

Hypertension is also becoming a significant health issue of great concern among the pediatric and adolescent population, and in most cases, it may be associated with early obesity[1]. Adolescent obesity has already been epidemic in the world, where the young people have been predisposed to various cardiovascular and metabolic diseases, such as hypertension[2]. High blood pressure during adolescence is a risk factor of hypertension during adulthood as well as a contributive factor to early damage of target organs highlighting the significance of early detection and treatment[3].

The limitations exist in traditional office-based blood pressure measurements especially in adolescents because of other factors as white coat hypertension, variation in measurements, and observer bias[4]. The Ambulatory blood pressure monitoring, on its part, is a more precise evaluation process because it involves the recording of the blood pressure at a particular time over a period of 24 hours, including the daytime and nighttime readings[5]. ABPM has also been found to identify masked hypertension and nocturnal hypertension which is often missed by conventional measurements but is clinically significant[6].

A high risk of sustained and masked hypertension is especially posed to obese adolescents, in large part because of a higher sympathetic nervous system activity, insulin resistance, and altered renal sodium handling[7]. It is important to identify hypertension at an early stage in the population because lifestyle modification, diet control, and pharmacological treatment of hypertension can be used to avoid cardiovascular complications in the long term[8].

A number of studies have indicated that ABPM is also better than office measurements in obese youth to identify hypertension with even a higher rate of daytime and nocturnal hypertension[1,3]. Moreover, ABPM gives an opportunity to measure blood pressure variability, circadian variability, and therapy response, which is useful to provide personalized management[5]. Irrespective of such strengths, the ABPM is not applied to the teen group in the regular clinical practice, which can be explained, in part, by its high costs, inaccessibility, and the ignorance of medical workers[2,6].

Moreover, the sign of early hypertension in obese adolescents is usually infrequent and thus risks of misdiagnosis occur when the measurements are only taken at the office occasionally[4]. ABPM can be included in the regular screening programs that obese adolescents undergo to help at an early stage identify those that are overweight, provide appropriate interventions and lower the morbidity of cardiovascular diseases in the long term[7].

The increased rate of obesity among children and the cardiovascular risks that are linked to it highlight the importance of adopting uniform screening approaches to the problem of hypertension in kids[8]. There is support on the use of ABPM as a useful method of properly measuring blood pressure among adolescents, especially those with obesity, which allows the clinician to diagnose and treat hypertension before the body suffers irreversible damages[3,5].

Objective: The proposed research will examine the advantages of ambulatory blood pressure monitoring in hypertension screening among obese adolescents to reveal the presence of undiagnosed hypertension and the investigation of blood pressure trends that may serve as the bases of early interventions.

METHODOLOGY

Study Design: It was a descriptive, cross-sectional study carried out to assess the suitability of the ambulatory blood pressure monitoring (ABPM) as a method of screening hypertension in obese adolescents. This is a descriptive study conducted at the Department of Cardiology Medical Teaching Institution Bannu, Department of Cardiology DHQ Teaching Hospital MTI DI Khan, Department of pediatrics Medical Teaching Institution, Bannu and

Department of Medicine Pak International Medical College Peshawar, from September 2021- Feb 2022.

Study Population: The population of the study was adolescents with ages between 12 to 18 years and diagnosed as obese based on World Health Organization (WHO) growth charts (BMI 95 th percentile based on age and sex). They recruited patients who attended outpatient pediatric and adolescent clinics of the hospital. The adolescents having known secondary causes of hypertension, chronic kidney disease, cardiovascular disorders or those who were already placed on antihypertensive therapy were not included in the study.

Sample Size: The sample size was determined on the basis of past prevalence estimates of hypertension in obese adolescents with an aim of having a 95% confidence level and 5% margin of error. One hundred and eighty individuals were recruited sequentially throughout the study period, and that satisfied the inclusion criteria and gave the informed consent.

Ethical Considerations: The study received the ethical approval of the Institutional Review Boards (IRBs) of the hospitals. All the participants got informed consent in writing with their parents or legal guardians and assent among the adolescents prior to enrollment. The information on the participants was kept as confidential during the study.

Data Collection: All the participants were recorded with baseline demographic and clinical data such as age, sex, height, weight, and body mass index (BMI). Sphygmomanometer was used to measure the blood pressure in the office according to standard guidelines. The participants were then subjected to 24-hour ABPM with an appropriate ambulatory blood pressure monitor. The device monitored the blood pressure at half-an-hour intervals during the day and at an hour-long time during the night. The participants were advised to carry on with their normal daily activities without engaging in intense physical activities during the period of monitoring.

Outcome Measures: The impact was mainly the identification of hypertension, which was defined by the age-, sex-, and height-specific percentile developed on adolescents. The data of ABPM were analyzed with respect to the average daytime, night time, and 24-hour blood pressure and nocturnal dipping patterns. The secondary outcomes were the finding of masked hypertension and white coat hypertension.

Data Analysis: All of the collected data were imported into a structured database and analyzed with SPSS version 25. Age, BMI and blood pressure readings were continuous variables and were expressed as mean and standard deviation (SD). The prevalence of hypertension, masked hypertension and white coat hypertension were categorical variable that was expressed in frequencies and percentages. Paired t-testing and t-tests were used to carry out comparative analyses between office blood pressure and ABPM readings, with a p-value less than 0.05 having been identified as statistically significant.

RESULTS

The sample of the study comprised 100 obese adolescents (58 males and 42 females). The age of the participants averaged 15.2 years with a standard deviation of 1.8 years and BMI of 32.5 with a standard deviation of 3.4 kg/m 2. **Table 1** shows base demographic and clinical features.

18% of participants reported elevated readings consistent with hypertension, according to office blood pressure measures. But according to ABPM, the prevalence was higher, with 30% of teenagers having hypertension. **Table 2** summarizes the comparison between ABPM and office measures.

Additionally, 8% of subjects with normal office blood pressure were shown to have concealed hypertension by ABPM. Furthermore, 5% of patients exhibited white coat hypertension, which was characterized by normal ABPM readings but increased office blood pressure (**Table 3**).

20% of participants had non-dipping nocturnal patterns, which is linked to an elevated risk of cardiovascular disease, and analysis of 24-hour ABPM readings showed greater average systolic and diastolic blood pressure during the day compared to at night (**Table 4**).

Lastly, stratification by sex showed that, although the difference was not statistically significant (p=0.47), men individuals had a little greater prevalence of hypertension than female participants (32.8% vs. 26.2%) (**Table 5**).

Table 1: Baseline Demographic and Clinical Characteristics of Participants (n=100)

Characteristic	**Value**
Age (years)	15.2 ± 1.8
Sex (Male/Female)	58/42
Height (cm)	162.3 ± 8.6
Weight (kg)	85.3 ± 12.7
BMI (kg/m²)	32.5 ± 3.4

Table 2: Comparison of Office BP and ABPM Results

Measurement Type	Normal BP (%)	Elevated BP (%)	p-value
Office BP	82	18	-
ABPM 24-hour Average	70	30	0.03

Table 3: Masked and White Coat Hypertension Detected by ABPM

Hypertension Type	Number of Participants	Percentage (%)
Masked Hypertension	8	8
White Coat Hypertension	5	5

Table 4: ABPM Daytime vs Nighttime Blood Pressure

Parameter	Daytime BP (mmHg)	Nighttime BP (mmHg)	Non-dipping (%)
Systolic BP	126.5 ± 12.2	115.3 ± 10.8	-
Diastolic BP	78.2 ± 9.5	68.7 ± 8.3	20

Table 5: Hypertension Prevalence by Sex

Sex	Number of Participants	Hypertensive (%)
Male	58	19 (32.8)
Female	42	11 (26.2)
Total	100	30 (30)

DISCUSSION

In this research, a higher rate of hypertension was recorded in obese adolescents under ambulatory blood pressure monitoring (ABPM) than in office blood pressure (OBP) measurements, which is in line with recent findings that reveal that ABPM has a greater ability to detect hypertensive cases and abnormal blood pressure trends than office blood pressure that is only measured (OBP)[9]. These results confirm the emerging opinion that OBP can be a poor predictor of actual blood pressure condition in high-risk children, especially in the case of obese children[10].

The masked hypertension (8%) in our cohort is in line with the literature reports that indicate ABPM detects those who look normotensive in clinic and have high ambulatory pressures. A variety of masked hypertension incidences among children and adolescents have also been reported by previous researches, highlighting the fact that the described condition is often unidentified by OBP solely[11,12]. Diagnosis of masked hypertension is a clinically significant issue, as it is linked to a higher susceptibility to cardiovascular damage of target organs and could be a reason to provide early treatment.

In the same way, the rate of white coat hypertension (5%), is in line with the literature which show a group of youths with a high OBP but normal ABPM values that depict the fact that the influence of the effects of white coats can confound diagnosis using exclusively clinic measurements[13,14]. The problem of white coat hypertension is not as prognostically deleterious as sustained ambulatory hypertension; however, it indicates the necessity to use confirmatory ABPM to prevent overtreatment.

Our results on nocturnal blood pressure dynamics, including a significant proportion of adolescents with a non dipping profile, are in line with the previous literature indicating that obese adolescents tend to experience lesser decreases in nocturnal

blood pressure than normative trends tend to do[15]. Blunted nocturnal dipping has been associated with cardiovascular risk factors and initial indicators of organ stress indicating that circadian blood pressure measurement using ABPM would provide valuable prognostic information compared to a daytime observation[16].

Comparative studies have noted that the abnormal ambulatory behavior like high blood pressure load or isolated nighttime hypertension frequently occurs in obese pediatric cohorts and is associated with the metabolic and cardiovascular risk factors[17]. Such studies point to the fact that obesity does not only raise the general prevalence of hypertension in the youth, but also has an effect on the severity and circadian nature of blood pressure, which offers an added risk factor to future morbidity.

Furthermore, studies that are intended to achieve predictive models of ambulatory hypertension by use of the OBP show that office values are not reliable in predicting ambulatory hypertension among obese children, even when optimized thresholds are used[18]. These data also confirm the clinical usefulness of ABPM to correctly classify and not to mislabel patients according OBP.

The observed differences on sex grounds, even though not significant, can be also viewed at the wider literature that implies that there is some variable blood pressure profile between males and females in the pediatric group. Hormonal, developmental and behavioral factors could also be involved in these differences although the mechanisms are not completely understood[19,20].

Combined, our findings and the comparison with the recent researches support the clinical usefulness of ABPM in obese adolescents. ABPM enables the identification of masked and white coat hypertension, provides information on circadian blood pressure dynamics, and better risk stratification than using OBP alone. ABPM as part of a regular high-risk screening in young people will thus help in identifying cases at an earlier stage and manage them appropriately in order to reduce the long term cardiovascular impact.

Limitations: This research has a number of limitations. The design is cross sectional and this rules out longitudinal changes in blood pressure and cause and effect relationships. Only one tertiary care hospital was used to sample, which could limit the generalizability of the results to the rest of the community or primary care setting. Moreover, the possible factors that may confound these results like diets, physical activities, socioeconomic status, and family history were not regulated, and they might affect the results of blood pressure. There might also be a difference in the compliance of the participants with the ABPM protocols, which might influence the accuracy of the data. Lastly, specific normative ABPM reference values to this population of adolescents had not been developed and this could affect the classification of hypertension and non dipping states among this particular population.

CONCLUSION

Ambulatory blood pressure monitoring can be used to detect hypertension at the early stages in the obese adolescents and this has been determined to detect cases that were not realized by traditional measurements in the office which includes masked and white coat hypertension. The paper demonstrates the need to measure 24-hour blood pressure trends, which includes nocturnal dipping, to gain a better insight into cardiovascular risk in this high-risk group. There is a possibility of preventing long-term cardiovascular complications by including ABPM into routine screening of obese adolescents to timely implement interventions, be able to make individualized management choices, and promptly guide patients toward interventions.

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