

Surveillance of Pediatric Hypertension Using Smartphone Technology

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ABSTRACT

Introduction: Elevated blood pressure is becoming increasingly common in the pediatric population. Hypertension costs nearly \$51 billion/year, and cardiovascular disease is responsible for 17% of the nation's health care expenditures. Traditionally, time-consuming and complicated interpretation standards result in infrequent pediatric blood pressure screenings. This may lead to the under-diagnosis of pediatric hypertension. Early detection of elevated blood pressure is important in order to prevent hypertension related conditions such as, target organ damage, left ventricular hypertrophy, and cerebrovascular disease. The aim of this study was to observe the prevalence of pediatric hypertension among children and adolescents age 3–18 using the smartphone application Pedia BP®. The purpose of this study was to (1) identify the prevalence of elevated blood pressure in a sample of children and adolescents and (2) evaluate any association between BMI, age, and blood pressure classification.

Method: A quantitative, descriptive study was conducted to evaluate the prevalence of pediatric hypertension in 81

preschool and school age children. App users were trained with the online take2heart course available at take2heart.com. The manual systolic and diastolic blood pressure readings were entered into the application, along with the patient's gender, age, height, and weight. Pedia BP® instantly calculated the blood pressure classification of the patient based on percentiles. Quantitative data from the Pedia BP® data repository were analyzed using descriptive statistics.

Results: We found that 54.3% of our sample were normotensive, 23.5% had prehypertension, 13.6% had stage 1 hypertension, and 8.6% had stage 2 hypertension. As seen in Figure 3, the majority of subjects with stage 1 (72.7%) and stage 2 hypertension (57.1%) were found in school-age children. We found that 3.7% of children were underweight, 48.1% were at a healthy weight, 21% were overweight, and 27.2% were obese.

Discussion: Pedia BP® was shown to be an effective screening tool to easily classify blood pressure readings on an individual basis. The prevalence of hypertension in our sample was higher than previously reported in the literature. Annual evaluation of blood pressures in preschool and school age children are warranted to identify and address hypertension. Pedia BP® was shown to be an effective screening tool to easily classify blood pressure readings on an individual basis. Pedia BP® offers benefits not only for patients, but for primary care providers, nurses, economists, insurance companies, hospitals, and clinics. Ultimately, Pedia BP® (1) increases awareness of elevated blood pressures among children and adolescents, (2) engages the health care community to screen for elevated blood pressures, (3) implements innovative technology, and (4) activates the potential for a population-based surveillance tool. *J Pediatr Health Care.* (2018) ■■■, ■■■-■■■.

KEY WORDS

Population-based surveillance, pediatric, hypertension, elevated blood pressure, smartphone technology

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INTRODUCTION

Hypertension, or high blood pressure, is among the leading modifiable risk factors for heart disease and

stroke, two leading causes of death among Americans (Farley, Dalal, Mostashari, & Frieden, 2010). According to the Centers for Disease Control and Prevention (CDC, 2018), nearly 67 million (1 in 3) adults in the United States have high blood pressure, and approximately 1,000 people die every day because of hypertension-related problems. Hypertension costs nearly \$51 billion annually, and cardiovascular disease is responsible for 17% of the nation's health care expenditures; this figure is expected to triple in the next 20 years (Heidenreich et al., 2011; Trogdon, Finkelstein, Nwaise, Tangka, & Orenstein, 2007).

The aim of this study was to observe the prevalence of pediatric hypertension among children and adolescents ages 3 to 18 years using the smartphone application Pedia BP® (Hope Busenius, take2heart initiative, Inc., Berkeley Lake, GA). The purpose of this study was to (a) identify the prevalence of elevated blood pressure in a sample of children and adolescents and (b) evaluate any association between body mass index (BMI), age, and blood pressure classification.

Hypertension is not a chronic disease exclusive to adulthood; it is becoming increasingly common in childhood (Falkner, 2009). Recent studies indicate that pediatric high blood pressure is on the rise (Boneparth & Flynn, 2008; Brady, 2015; Moyer, 2013; Önsüz & Demir, 2015), showing the prevalence to be anywhere from 1% to 15% (Gulati, 2006; Moraes, Lacerda, Moreno, Horta, & Carvalho, 2014; Moyer, 2013; Önsüz & Demir, 2015). This large span in rates of abnormal pediatric blood pressures supports the need for further investigation into the true prevalence of pediatric hypertension.

Although high blood pressure is asymptomatic in most cases, the physical adverse effects that take place in the body are severe (Centers for Disease Control and Prevention, 2018). Hypertension in early life has been shown to be associated with target organ damage (Drozd & Kawecka-Jaszcz, 2013; Falkner, 2009; Flynn, 2008a; The Fourth Report, 2004; Redwine & Daniels, 2012; Stergiou et al., 2013) left ventricular hypertrophy (The Fourth Report, 2004; Lurbe et al., 2005; Redwine & Daniels, 2012), and poor neurocognitive function (Lande et al., 2017). Sustained hypertension is also a strong risk factor for coronary artery disease, arrhythmias, heart failure, peripheral artery disease, and renal damage (Drozd & Kawecka-Jaszcz, 2013).

Not only is identification of pediatric hypertension important to prevent cardiovascular complications in childhood, previous research has also shown that a child or adolescent with hypertension is far more likely to have hypertension as an adult (Flynn, 2008b; The Fourth Report, 2004; Moyer, 2013). Therefore, identification of those at higher risk for developing cardiovascular disease later in life is essential for health promotion and is paramount to a healthy adult life. Unfortunately, proper identification and diagnosis of pediatric

hypertension is difficult to accomplish. Interpreting a pediatric blood pressure reading is more complicated than interpreting an adult blood pressure reading. Although the standards for a normotensive adult are equal across multiple variables, the blood pressure of a child or adolescent depends on percentiles according to sex, age, and height (Anyaegbu & Dhamidharka, 2014; The Fourth Report, 2004; McCrindle, 2010; Moyer, 2013). A pediatric patient with a systolic or diastolic blood pressure between the 90th and 95th percentile is considered *prehypertensive*, and a reading above the 95th percentile is considered *hypertensive* (Luma & Spiotta, 2006; Moyer, 2013). Identifying a child or adolescent with hypertension is a lengthy process that requires at least 15 minutes to take and interpret the blood pressure (Busenius, Batsky, Wold, Chalmers, & Williams, 2015). As a result, children do not consistently receive accurate blood pressure readings as often as necessary, with screening occurring in 67% and 35% of preventive care and ambulatory visits, respectively (Moyer, 2013). Moreover, 40% of pediatricians have reported feeling uncomfortable diagnosing and evaluating hypertension, and nearly 80% of high blood pressures go undetected in the clinical setting (Boneparth & Flynn, 2008; Brady, 2015). Consequently, current methods of screening may not always yield accurate results. The problem guiding this research is that the true prevalence of pediatric hypertension is unknown and may be underdiagnosed because of the lack of standardized interpretation.

The smartphone application Pedia BP® was developed to simplify and standardize the method of interpreting a pediatric blood pressure reading. The application has over 75,000 users in over 30 countries (Busenius et al., 2015). The take2heart initiative was also a significant component to this research. The initiative offers a free online course on how to take an accurate blood pressure reading for children and adolescents and direct download of the Pedia BP® smartphone application. Blood pressure measurement guidelines set forth by the National High Blood Pressure Education Program are reinforced in the take2heart initiative and ensure that the correct cuff size and equipment are used to take an accurate blood pressure reading. It is recommended that blood pressure screening begin at age 3 years (The Fourth Report, 2004).

With implementation of modern technology, Pedia BP® standardizes the interpretation of a blood pressure reading and simplifies the process of screening

Interpreting a pediatric blood pressure reading is more complicated than interpreting an adult blood pressure reading.

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