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COMMENTARY

Epidemiology of hypertension and survey protocols: how to count counts

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Hypertension in children is currently defined as a systolic blood pressure (BP) and/or diastolic BP that is, on at least three separate evaluations, at or above the 95th percentile for sex, age and height.[1] The importance of the number of evaluations is clearly shown in the meta-analysis provided by Sun *et al.*[2] because the prevalence of hypertension in childhood is reduced to 12.1% after the first evaluation, 5.6% after the second evaluation and 2.7% after the third evaluation. This study[2] has relevant implications for epidemiology, clinical medicine and public health.

Hypertension is now the leading risk factor for death at the global level. A reliable estimation of hypertension prevalence in epidemiological studies is essential to calculate the burden of future cardiovascular events and costs of intervention policies. A perspective study by Sun *et al.*[2] demonstrates the importance of considering the protocol when reading a survey aimed at estimating the number of subjects at risk in a country and when performing a comparison between surveys to assess the presence of hypertension in different countries. Most surveys performed in low-income countries have assessed the hypertension burden based on measurements obtained at a single evaluation. This screening approach is aimed at estimating the total number of subjects at risk, although the clinical diagnosis should be confirmed. With this approach, the possibility of a false-positive diagnosis in a single patient is high. When the aim of the survey is to estimate the costs of drug treatment at the national level, the number of false-positive diagnoses will be contained, and more than one evaluation will be performed.

In a wide national survey that enrolled subjects between 15 and 69 years of age,[3] misclassification was common at young ages, and two-thirds of men aged less than 30 years had normal BP values at the second evaluation.[4] The data provided by Sun *et al.*[2] confirm that misdiagnosis is even more evident in children. For between-country comparisons, focusing attention on the protocol adopted in surveys may avoid incorrect generalizations. Differences in hypertension prevalence between Northern Europe (Switzerland 2.2% and Hungary 2.5%)[5,6] and Southern Europe (Turkey 9% and Portugal 13%)[7,8] may thus be attributed to the different survey protocol (three evaluations *vs* one evaluation in the two areas) rather than to the country latitude. Similar results are observed when the low prevalence of hypertension in Yemen, where the data were obtained at two evaluations, are compared with the surveys performed in other low-income countries in a single evaluation.[9]

From the point of view of clinicians, the distinction between screening and diagnosis in clinical practice is crucial for elderly individuals. The initiation of inappropriate antihypertensive treatment before establishing a final diagnosis may indeed expose the patient to the risks of hypotension and falls causing hip fracture. This point is well recognized in common clinical practice, and repeated BP measurements are usually performed in the elderly at different visits. More representative BP values are also determined with out-of-hospital measurements before starting drug treatment.[10] In contrast, in children, the main risk seems to be an underestimation. First, BP is less commonly measured in children than in adults. In the emergency departments of the United States, between 5.3 and 66% of children underwent BP measurements.[11,12] In the United Kingdom this value was ~9%.[13] Second, measuring BP in children is more difficult than in adults, and for pediatric clinicians, recognizing hypertensive children is not simple. As opposed to adults, the definition of hypertension in children is based on the normal distribution of BP in healthy children (percentile for sex, age and height), and not on the cardiovascular morbidity and mortality associated with a certain BP level.[1] Although normal and abnormal BP value tables and electronic programs exist, it may be difficult for pediatric clinicians to integrate these tools into their work flow. In a large cohort study, 14 187 children and adolescents aged 3–18 years were observed at least 3 times for well-child care.[14] Of 507 children and adolescents (3.6%) who had hypertension, only 131 (26%) had a diagnosis of hypertension or elevated BP documented in the electronic medical record.[14] Similar findings were also reported in Europe. Additionally, the normative values used, which are limited to the United States, may not apply to other parts of the world.[15] The data are more than 20 years old, and the current epidemics of overweight status and obesity may have changed the criteria. Hypertension is thus frequently undiagnosed in the pediatric population.

Secondary hypertension is generally accepted to be much more common in children and adolescents than in the adult population. However, recent reports have highlighted that the increasing prevalence of primary hypertension is strongly linked to an increase in childhood obesity. Childhood obesity is currently the most common nutritional problem in developed and developing countries. Obesity in children has doubled

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since the mid-1980s, reaching pandemic proportions and increasing not only in prevalence but also in severity. Obese youth are more likely to have risk factors for cardiovascular disease such as high cholesterol or high BP. Due to the need to initiate lifestyle changes in patients, the prompt recognition of patients at high cardiovascular risk is crucial. In overweight and obese children, lifestyle interventions incorporating a dietary component along with exercise or behavioral therapy can lead to improvements in both weight and cardio-metabolic factors, including BP.[1] BP has been shown to follow a tracking pattern, and children with BP values at the higher end of the BP distribution are more likely to develop high BP as adults. Should we thus consider the large group of children with hypertension at the first evaluation as normal? Disregarding the value of high BP values at screening independently from obesity-related diagnoses might limit the value of prevention. In false-positive children with other risk conditions, especially obesity, BP should still be regularly monitored, with prompt initiation of lifestyle changes (physical exercise) and elimination of as many cardiovascular risk factors as possible to prevent an increase in BP with age.[16] The barriers to accurately quantifying salt consumption in the pediatric population are especially prominent. However, strategies aimed at reducing body weight and the consumption of salt-rich foods would seem to be a sounder policy than waiting.[17]

In conclusion, Sun *et al.*[2] offer a clear quantitative estimation of the hypertension burden in children assessed at the first, second and third evaluations. This information is crucial for reading epidemiological studies. However, although no prospective data are available, this information must be kept distinct from the importance of pursuing corrections of lifestyle changes in children at risk.[18] From this perspective, BP measurement is an opportunity to involve the whole family in a virtuous shared effort to achieve lifestyle changes.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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