Editorial Commentary

Changing Relationship Among Office, Ambulatory, and Home Blood Pressure With Increasing Age
A Neglected Issue

George S. Stergiou, Angeliki Ntineri, Anastasios Kollias

See related article, pp 1073–1079

In this issue, Conen et al.1 reported data showing changing relationship between office blood pressure (OBP) and awake ambulatory BP (aABP) with increasing age. This observation is not new,2–5 but it is largely neglected and ignored and has major clinical implications.

BP is known to increase with aging, leading to increasing hypertension prevalence. This applies to BP measurements in and out of the office (Figure).1–3 The problems start here because, as Conen et al confirmed, the range of BP rise with age is much higher (about double) for OBP than aABP.1–3 As a result, a practical problem emerges because the relationship between OBP and aABP is not the same across all the age groups.

There is convincing evidence that in children and adolescents the relationship among OBP, aABP, and home BP (HBP) is not the same as in the adults. A comparison of normalcy tables currently recommended for defining hypertension in children and adolescents showed that the corresponding percentiles are consistently lower for HBP than for aABP.3 Moreover, there is a trend for OBP to be lower than HBP and aABP in younger children, yet this difference is progressively eliminated with increasing age. The findings in regard to aABP might be attributed to high level of physical activity of the young individuals during the day (increases aABP), whereas the findings for HBP might be because of inability of the young children to remain still during repeated HBP measurements (increases HBP) (Table). The latter observation is derived from a school-based study (n=765) that showed the corresponding percentiles are consistently lower for HBP than for aABP.3

Moreover, there is a trend for OBP to be lower than HBP and aABP in younger children, yet this difference is progressively eliminated with increasing age. The findings in regard to aABP might be attributed to high level of physical activity of the young individuals during the day (increases aABP), whereas the findings for HBP might be because of inability of the young children to remain still during repeated HBP measurements (increases HBP) (Table). The latter observation is derived from a school-based study (n=765) that showed the corresponding percentiles are consistently lower for HBP than for aABP.3

In 2010, we reported data from 696 subjects aged 5 to 78 years, all of whom had OBP, aABP, and HBP measurements using the same protocol.1 The main conclusion was that (1) in children and adolescents aABP is higher than HBP and OBP and (2) in older subjects the aABP–HBP difference is eliminated and the aABP–OBP difference is progressively inverses. We recently expanded this data set and performed an updated analysis in 642 untreated subjects aged 5 to 78 years (unpublished data) and confirmed that (1) the crossing age point where aABP becomes higher than OBP is at 21 years and (2) HBP is lower than aABP in children, adolescents, and young adults up to the age of 40 years, and then tends to have similar values up to 60 years, and later on might be higher than aABP (Figure).

The key finding presented by Conen et al.1 is that OBP is lower than aABP up to the age of 50 years, and this relation is reversed in older subjects (Figure). This change in the OBP–aABP relationship resulted in low prevalence of white-coat hypertension and high of masked hypertension in young people, and the reverse in old ones. Strengths of this analysis are that (1) it is based on random population studies, (2) included a large sample (n=9550), and (3) all were untreated for hypertension. Limitations are that (1) an incomplete picture of the age spectrum is provided because children and adolescents were not included, (2) there are no HBP data, (3) OBP was based on 2 readings on a single occasion, which is too little information for a measure known to be unstable and poorly reproducible, (4) OBP was obtained at the person’s home or at an examination center, whereas the diagnostic HBP threshold is not the same as for OBP; and (5) these findings are based on untreated population samples and may differ in subjects with elevated BP or treated for hypertension.

Common in the 3 studies comparing OBP with aABP is the age point of change after which their relationship is reversed with higher OBP than aABP.1–3 This is at 50 years in the data by Conen et al1 and Ishikawa et al2 compared with 21 years in the young...
than OBP, and in case of diagnostic disagreement between ABP is a much stronger predictor of cardiovascular risk in the usual environment and activities. Therefore, it is not a surprise that ABP is based on 30 to 50 readings taken in the individual's setting, whereas the OBP–aABP relationship is unpredictable. OBP is based on 2 to 3 measurements taken in an artificial setting, whereas our data set. Although this is a major disagreement, it seems to be largely driven and explained by differences in hypertension prevalence (elevated aABP), which was almost double across all the age groups in our study that included subjects attending a BP clinic. In the studies by Conen et al and Ishikawa et al, average systolic aABP of adults was at ≈128 versus 140 mm Hg in our study, suggesting large difference in hypertension prevalence, However, at the age point of OBP–aABP difference reversal (50, 50, and 21 years, respectively) aABP was at ≈130 mm Hg in all the 3 studies (Figure). Thus, the prevalence of hypertension seems to be a key factor for the OBP–aABP relationship, because it is accompanied by increased prevalence of the white-coat phenomenon. In other words, the greater increase in OBP than aABP with aging is because of increased hypertension prevalence, which induces the white-coat phenomenon.

Figure. Relationship between age and blood pressure assessed by different methods. Dotted horizontal line indicates hypertension threshold based on awake ambulatory blood pressure. Conen et al, Ishikawa et al, and Stergiou et al.

Table. Factors Affecting Blood Pressure Measured by Different Methods in Young and Old Subjects and Implications

<table>
<thead>
<tr>
<th>Age</th>
<th>Factors</th>
<th>Effects</th>
<th>Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young</td>
<td>↑ Physical activity; job strain</td>
<td>Awake ABP</td>
<td>↑ Prevalence of masked hypertension</td>
</tr>
<tr>
<td>Old</td>
<td>↓ Physical activity; retirement</td>
<td>Awake ABP</td>
<td>↑ Prevalence of white-coat hypertension</td>
</tr>
</tbody>
</table>

ABP indicates ambulatory blood pressure; and BP, blood pressure.

Diagnostic disagreement is inevitable when using >1 BP measurement methods in clinical practice and getting around this problem is a challenge. Moreover, in the individual patient the OBP–aABP relationship is unpredictable. OBP is based on 2 to 3 measurements taken in an artificial setting, whereas aABP is based on 30 to 50 readings taken in the individual's usual environment and activities. Therefore, it is not a surprise that ABP is a much stronger predictor of cardiovascular risk than OBP, and in case of diagnostic disagreement between them (white-coat or masked hypertension), the risk is dictated by ABP. For these reasons a straightforward approach would be to retain OBP for wide scale screening, but when ABP is available to base decisions exclusively on this method and ignore OBP. As for the diagnostic ABP threshold, indeed this has been derived from outcome studies in adults aged >50 years. In young people such studies are not feasible and distributional criteria have been used to define ABP thresholds in children and adolescents. Defining ABP normalcy through its relationship with preclinical organ damage (left ventricular mass) is a sensible approach for young subjects that needs to be addressed in future studies.

Disclosures

None.

References

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诊室血压、动态血压和家庭血压之间的关系随着年龄的不断增加而发生变化
一个被忽视的问题

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相关文章请见：

C onen等[11]报告的数据显示诊室血压（office blood pressure, OBP）与清醒动态血压（awake ambulatory blood pressure, aABP）之间的关系随着年龄的不断增加而发生变化。这个观察结果很常见[2-4], 大多数时候被人们所忽视，但却具有重要的临床意义。

众所周知，血压会随着年龄的增长而升高，进而导致高血压的患病率增加。诊室以及诊室外的血压测量均如此（图1）[1-3]。Conen等证实，OBP随年龄增长而上升的幅度比aABP高得多（大约2倍）[1-3]。OBP与aABP之间的关系在所有年龄组间并不一致。

有研究证据表明，儿童和青少年的OBP，aABP和家庭血压（home blood pressure, HBP）之间的关系与成人的不同。与目前推荐的用于定义儿童和青少年高血压的标准进行比较后显示，HBP的相应百分位数始终低于aABP[5]。此外，在较幼年龄段中，OBP低于HBP且HBP，然而这一差异随着年龄的增长而逐步消失。OBP低于aABP可能与年轻个体对日间的体力活动水平高有关（增加aABP），而低于HBP是由于幼儿在反复HBP测量过程中无法保持安静（HBP偏高）(表1)。研究显示儿童年龄为6-12岁时HBP高于OBP，在青少年中这一差异消失[6]。上述现象造成的结果是，在儿童和青少年中，通过aABP或HBP检测的危险性高血压的患病率似乎高于白大衣高血压或持续性高血压[7-9]，其临床意义不确定。

既然已经知道年轻受试者OBP，aABP和HBP之间的关系与成年人不同，一个明显的问题就是在什么年龄这种关系会发生改变（可能是一种渐进的变化）以及有哪些介入因素（表1）。

2011年，Ishikawa等[12]发表了一项包含34项研究（n=16 148）的meta分析，探究随着个体年龄的增加诊室内以及诊室外血压之间的变化关系（图1）。该分析纳入10-90岁采用OBP以及aABP或HBP测量的经治疗的血压正常者或高血压患者。结论是OBP收缩压随年龄增加而升高的程度较aABP更为显著，并且在50岁以后开始高于aABP。HBP在所有年龄段均低于OBP，并且在较年轻受试者中也低于aABP，而在较老年者中开始变得相似。

2010年，我们报告了696例年龄在5-78岁受试者的研究数据，采用相关研究方案检测所有受试者的OBP，aABP和HBP[10]。其主要结论是：(1) 在儿童和青少年中，aABP高于HBP和OBP；(2) 在较老年受试者中，aABP与HBP之间的差异消失，而aABP与OBP之间的差异逐渐减小。最近，我们扩展了该数据集，针对5-78岁642例未经治疗的受试者进行了重新分析（数据未发表），并且证实：(1) aABP开始高于OBP的交叉年龄点为21岁；(2) 在儿童、青少年和40岁以上青壮年中HBP低于aABP，之后两者数值趋近，直至60岁，而HBP可能高于aABP（图1）。

Conen等[11]研究的主要发现是50岁前OBP低于aABP，而在较老年受试者中这一关系发生逆转（图1）。OBP与aABP之间关系的这种变化导致了年轻中白大衣高血压的患病率较低，而隐蔽性高血压的患病率较高，老年人中则相反。这项研究的优势在于：(1) 建立在随机人群研究的基础上；(2) 受纳样本最大（n=9550）；(3) 所有受试者均未经高血压治疗。局限性包括：(1) 由于未纳人儿童和青少年, 故所提供的年龄谱不完整；(2) 无HBP数据；(3) OBP

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是基于2个单次的测量值数读，一次测量所提供的信息太少，数据不稳定且难以复制。4) OBP在个人家中或检查中心测得，而诊断HBP阈值与OBP不一致；5) 这些研究发现基于未经治疗的人群样本，可能与血压升高或经高血压治疗的受试者有所不同。


当临床实践中采用1种以上血压测量方法时，出现诊断结果不一致是在所难免的，但解决这一问题仍是一个挑战。而且个体患者的OBP-aABP关系是无法预测的。OBP是一个基于人为环境中2-3次的测量值，而aABP是基于个体日常环境以及日常活动中30-50次的测量读数。因而毋庸置疑，ABP对于心血管风险的预测强于OBP，如果两者之间出现诊断结果不一致（白大衣高血压或隐蔽性高血压），应该根据ABP来确定风险[3]。基于这些原因，简单的方法应该是有大规模研究时采用OBP，但是当只能根据ABP这一方法作出诊断时，应该采用ABP而忽略OBP[8]。关于ABP的诊断阈值，>50岁成年人的数据已由结局研究（outcome study）得出[4]，这类研究在年轻人中并不可行，可用分布标准来定义儿童和青少年的ABP阈值[5]。对于年轻受试者，通过ABP与临床前器官损伤（左心室质量）之间的关系来界定ABP常态是一种明智的方法，未来需开展研究进行探讨。

参考文献