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,\(^2\)\(^-\)\(^4\) 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.\(^1\) 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.\(^1\) 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 inverted. We recently expanded this data set and performed an updated analysis in 642 untreated subjects aged 5 to 78 years (unpublished data) and confirmed that (1) the crossing age point where aABP becomes higher than OBP is at 21 years and (2) HBP is lower than aABP in children, adolescents,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 al\(^1\) and Ishikawa et al\(^2\) compared with 21 years in

**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 2011, Ishikawa et al\(^2\) published a meta-analysis of 34 studies (n=16148) investigating the relationship between office and out of office BP with increasing age (Figure). This analysis included untreated normotensives or hypertensives aged from 10 to >90 years with OBP and either aABP or HBP measurements. The conclusion was that systolic OBP increases with age more steeply than aABP and becomes higher than aABP after the age of 50 years. HBP was lower than OBP at all ages and also lower than aABP in younger subjects becoming similar in older ones.

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 inverted. 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).

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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 usual environment and activities. Diagnostic disagreement is inevitable when using >1 BP measurement methods in clinical practice and getting around the white-coat phenomenon is a challenge. Moreover, in the individual patient measurement methods in clinical practice and getting around differences in hypertension threshold based on awake ambulatory blood pressure. Constructed from data reported by Conen 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.

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

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; unable to remain still during repeated home BP monitoring (children)</td>
<td>↑ Awake ABP</td>
<td>↑ Prevalence of masked hypertension</td>
</tr>
<tr>
<td>Old</td>
<td>↓ Physical activity; retirement; ↑ Orthostatic hypotension; ↑ Prevalence of hypertension and thereby of white-coat phenomenon</td>
<td>↓ Awake ABP</td>
<td>↑ Prevalence of white-coat hypertension</td>
</tr>
</tbody>
</table>

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

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

George S. Stergiou, Angeliki Ntini, Anastasios Kollias

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[1]发表了一项包含34项研究（n=16148）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测量的未经治疗的血压正常者和高血压患者。结论是OBP收缩压随年龄增加而升高的程度较aABP更为明显，并且在50岁以后开始高于aABP，HBP在所有年龄段均低于OBP，并且在较高受试者中也低于aABP，而在较老年者中开始变得相似。

2010年，我们报告了694例年龄在5-78岁受试者的研究数据，采用相同研究方案检测所有受试者的OBP，aABP和HBP[1]。其主要结论是：(1) 在儿童和青少年中，aABP高于HBP和OBP；(2) 在较年老受试者中，aABP与HBP之间的差异消失，而aABP与OBP之间的差异逐渐逆转。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在60岁时高于OBP，在78岁时这一差异消失[4]。上述现象造成的结果是，在儿童和青少年中，通过aABP或HBP检测到的隐蔽性高血压的患病率与高于白大衣高血压或持续性高血压[5,7]，其临床意义不明确。

The opinions expressed in this editorial are not necessarily those of the editors or of the American Heart Association.

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the OBP–aABP relationship, because it is accompanied by
be largely driven and explained by differences in hypertension
mass) is a sensible approach for young subjects that needs to
its relationship with preclinical organ damage (left ventricular
be addressed in future studies.

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distributional criteria have been used to define ABP thresholds
its basis of normalcy tables.
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Table 1  In young and elderly subjects the use of different methods for measurement of
differential pressure

<table>
<thead>
<tr>
<th>年龄</th>
<th>影响因素</th>
<th>效应</th>
<th>意义</th>
</tr>
</thead>
<tbody>
<tr>
<td>老年人</td>
<td>体力活动</td>
<td>↓</td>
<td>直立性低血压</td>
</tr>
<tr>
<td>年轻人</td>
<td>体力活动</td>
<td>↑</td>
<td>高血压的患病率以及由</td>
</tr>
</tbody>
</table>


是基于2个单次的测量值读数，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)这些研究发现是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。

均收缩压为128 mmHg，而我们的研究[3]为140 mmHg，这提示研究对象人群高血压患病率存在巨大差异。但是，在所有3项研究中在OBP与aABP之间发生逆转的年龄点不同（分别为50岁，50岁，21岁）[1-3]。因此，高血压的患病率看来是影响OBP与aABP之间关系的一个关键因素，原因在于其伴随着白大衣高血压患病率的增加。换言之，OBP随着年
龄增加而不断在aABP是由于高血压患病率的升高所引
起的白大衣现象。

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
日常生活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（白大衣高血压或隐藏性高血压），应

参考文献