Limited accuracy of the hyperbaric index, ambulatory blood pressure and sphygmomanometry measurements in predicting gestational hypertension and preeclampsia

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ABSTRACT

Objective
The aim of this study was to validate the hyperbaric index (HBI) for first trimester prediction of preeclampsia and gestational hypertension.

Methods
Participants were low-risk and high-risk nulliparous women and high-risk multiparous women, and were recruited between April 2004 and June 2006. At a gestational age of 9 weeks (range 8 – 11 weeks), blood pressure was measured first by sphygmomanometry and thereafter by ambulatory blood pressure measurement (ABPM) for 48 h. The first 90 low-risk women who had an uneventful pregnancy formed the reference group for calculation of a time-specified tolerance interval with 90% confidence limits. In the validation group, consisting of the remaining women, the HBI was calculated as the time-specified blood pressure excess over this tolerance limit for SBP, DBP and mean arterial pressure.

Results
The validation group contained 101 women. Fifteen developed preeclampsia and 13 gestational hypertension. For preeclampsia the maximum HBI had the best predictive capacity with a sensitivity of 73 % and a specificity of 86 %. However, the difference with standard ABPM measurement or sphygmomanometry was small with a sensitivity between 75 % and 73 % and a specificity between 86 % and 95 %. The predictive efficacy for gestational hypertension predictive capacity was poor with all methods (sensitivity between 54 % and 77 %, specificity between 41 % and 78 %).

Conclusion
Standardized sphygmomanometry, ABPM measurement and the hyperbaric index calculated from 48 h ABPM had a comparable, restricted predictive efficacy. The high predictive value of hyperbaric index as observed in earlier studies could not be reproduced.
INTRODUCTION

Preeclampsia is one of the main causes of maternal and fetal morbidity and mortality worldwide. ¹ The exact pathophysiology is unknown despite extensive research. Many hypotheses have been proposed and rejected. Although preeclampsia is usually diagnosed in the second half of pregnancy, it is hypothesized that the disease originates early in pregnancy with defective placentation.² Early selection of women at high risk for this condition could offer the opportunity to target care at those most likely to benefit and to evaluate or design preventive strategies. However, currently available diagnostic tests have limited predictive efficacy with likelihood ratio’s for a positive test of 2-5 and likelihood ratio for a negative test of 0.2–0.8.²-⁴

Blood pressure measurement as a predictive tool has been the focus of research for many years. Although women who will develop preeclampsia later in pregnancy have a slightly higher blood pressure in the beginning of pregnancy⁵-⁷ the discriminative capacity of blood pressure is disappointing, irrespective of blood pressure measurement technique.⁴;⁶;⁷ Ambulatory blood pressure measurement (APBM) is a well known technique for the diagnosis and treatment evaluation of hypertension in nonpregnant women. ABPM correlates better with hypertension-related organ damage and cardiovascular events than office blood pressure.⁸ Using ABPM, a higher blood pressure was observed in mid-pregnancy in women who later experienced the development of preeclampsia or gestational hypertension. Although the predictive efficacy of ABPM was higher than standard blood pressure measurement the predictive capacity appeared to low to be useful in daily clinical practice.⁶;⁹-¹¹

Most studies regarding the prediction of preeclampsia or gestational hypertension present 24-h means. Although some studies report that diurnal differences can be used for assessing disease severity, usefulness for prediction has not been reported.¹²;¹³ A more sophisticated technique for evaluation of ABPM was presented by Hallberg et al., using the hyperbaric index (HBI).¹⁴ HBI was calculated as the amount of blood pressure excess during the measurement period above a 90% tolerance limit expressed as mmHg multiplied by hour. Studies by Hermida et al. evaluated HBI as a test for prediction of preeclampsia and gestational hypertension.¹⁵-¹⁸ These studies observed a sensitivity of 94% and a specificity of 100% using HBI calculation from 48-h ABPM. Another group studied HBI, calculated in a different way, in a hospital-based research setting and observed a sensitivity of 80% and specificity of 77% at 8-16 weeks for gestational hypertension and preeclampsia.¹⁹
Because the results from the studies by Hermida et al. seemed promising and the research setting between all studies differed we decided to perform a validation study in our own population.15-19

METHODS

Subjects
This research is part of a prospective study, which investigates cardiovascular parameters in the beginning of pregnancy for the prediction of preeclampsia and fetal growth restriction. Healthy nulliparous women at low risk and women with elevated risk for preeclampsia or fetal growth restriction were included between April 2004 and June 2006. Low-risk participants were recruited by advertisements in local newspapers and flyers at midwife practices near our hospital. Women having diabetes, renal disease, clotting disorders or a previous pregnancy complicated by preeclampsia were defined as high risk. They were recruited from our antenatal clinic (Academic Medical Center, Amsterdam, The Netherlands) and by advertisements in local newspapers. At inclusion, all women had normal blood pressure (less than 140 mmHg SBP and 90 mmHg DBP, measured auscultatory) and none used antihypertensive medication. Only women with a singleton pregnancy were included. Three women who delivered an infant with major congenital malformation were excluded.

After written informed consent was obtained, all participants underwent identical study protocols. At 8-11 weeks, blood pressure was measured first by conventional sphygmomanometry and thereafter for 48 h using an ambulatory blood pressure device (see below). Gestational age was defined by first trimester ultrasound. The results of the ambulatory blood pressure measurements were not available for the clinicians/midwives responsible for prenatal care. Pregnancy outcome was classified as ‘gestational hypertension’, ‘preeclampsia’ or ‘normal’ using blood pressure measurements that were obtained during routine clinical care. Two obstetricians (H.W. and K.B.) who were unaware of the results of the early gestational blood pressure measurements reviewed medical files for classification.

The Medical Ethical Committee of the Academic Medical Center approved the study.

Definitions

Gestational hypertension was defined as a systolic blood pressure (SBP) of at least 140, diastolic blood pressure (DBP) of at least 90 mmHg or both after 20 weeks in a previously normotensive woman, measured twice with an interval of at least 6 h. Blood pressure was measured under routine clinical conditions. Preeclampsia was defined as
the combination of gestational hypertension and proteinuria of at least 0.3 g/ 24 h or dipstick of at least ++ after 20 weeks gestation according to the International Society for the Study of Hypertension in Pregnancy (ISSHP) guidelines.20

**Instruments**

Blood pressure was measured by aired sphygmomanometry in supine position at the nondominant arm after at least 15 minutes of rest in a quiet room with an ambient temperature between 20-22° C between 0700 and 1200 h. Korotkoff V was used to determine DBP. The average of three measurements with an interval of at least 1 minute was used for calculations. The mean arterial pressure (MAP) was calculated as ((2x DBP) + SBP)/3. ABPM was performed by oscillometry (Spacelab 90207, Redmond, Washington, USA). An appropriately sized cuff was placed on the non-dominant arm. Blood pressure was measured every 30 minutes between 06:00 h till midnight and every 60 minutes between midnight and 0600 h. All women started the measurements between 0700 and 1200 h and continued for 48 consecutive hours. If blood pressure results were missing for more than 2 h the participant was excluded from further analysis.21 The participants were instructed to maintain their daily routine and to complete a diary to identify time of sleeping and awakening. Mean 24-h blood pressure, daytime blood pressure and night-time blood pressure using fixed intervals (between 0600 h till midnight and between midnight and 0600 h) and night to day ratio were calculated.22 Women were defined as ‘dippers’ when their night to day ratio SBP was 0.90 or less.23 All women were instructed and measured by two trained researchers.

**Computation of time-specified tolerance interval of blood pressure and hyperbaric index**

The calculation of nonparametric tolerance intervals for hybrid time series and HBI was performed according to the method described by Hermida et al.17,18 Measurement data from the first 90 nulliparous women who had an uneventful pregnancy and delivered at term of an infant with normal birthweight24 were used for calculation of the time-specified tolerance limits (reference group). The remaining 101 women, including those with gestational hypertension or preeclampsia, constituted the validation group. On the basis of self-reported sleeping and waking times, data were synchronized at mid-sleep. Because the time of blood pressure registration differed between participants, 2-hour time classes were defined at each complete hour of day (running from one before to one hour after each complete hour), resulting in overlapping time classes. Individual data were averaged per time class, producing one blood pressure result per individual per time class. For each time class, the 90% confidence limits were calculated across all participants. Because the reference group was small and normality and symmetry of the
data could not be assumed, a nonparametric approach was chosen using bootstrapping, as described by Hermida et al.\textsuperscript{17} The tolerance interval was calculated to include at least a specified proportion of the population \((1-\beta)\) with a stated confidence \((1-\alpha)\). We chose to compute for given time class a tolerance interval which included at least 90% of the population with a confidence of 90% \((\beta = 0.1\) and \(\alpha = 0.1)\). The assumption was that the sample was a reasonable representation of the underlying population. Data in each time class was bootstrapped (resampled with replacement); the bootstrapped data contained the same number of records as the original sample. Bootstrapping was repeated until the standard error of the mean (SEM) was less than 1% of the mean (the Monte Carlo stopping rule).

For computing tolerance intervals, the mean and variance of the sample and of each of the bootstrapped resample were calculated. For each resample a lower \((\beta/2, \text{e.g. } 5\%)\) and upper \((1-\beta/2, \text{e.g. } 95\%)\) percentile was determined, thus creating a large number of upper and lower limits for each time class (one for each bootstrap resample). Because we were interested in the proportion of the population with confidence \(1-\alpha\), from all the (bootstrap) lower percentiles, the \(1-\sqrt{1-\alpha}\) percentile was determined: the lower tolerance limit. From the upper percentiles, the \(\sqrt{1-\alpha}\) percentile was determined: the upper tolerance limit. There is \(\sqrt{1-\alpha}\) probability that a sample from the specified population lies over the upper tolerance limit; there is also \(\sqrt{1-\alpha}\) probability that the

![Figure 1](image)

**Figure 1.** Time-specified tolerance intervals with 90% confidence limits for SBP, DBP, mean arterial pressure and heart rate in the reference population \((n=90)\) synchronized at midsleep.
sample lies under the lower tolerance limit: the probability that the sample lies between both tolerance limits is therefore $1 - \alpha$ (rule of conditional probability). Upper and lower tolerance intervals were computed for all time classes, see figure 1.

The size of the reference population was determined by stepwise increment of the reference population by 10 women and calculation of the standard error (SE) of the 90th percentile tolerance limit. After a group size of 70, further increase resulted in a variation of the SE of less than 2 mmHg. Therefore calculations of the tolerance limits were discontinued at a group size of 90.

The HBI was calculated for the SBP, DBP and MAP as the individual excess above the reference threshold (the upper limit of the tolerance interval) using numerical integration (for an example see figure 2). $HBI_{\text{max}}$ was defined as the maximum value of either the HBI of SBP, DBP or MAP for each individual. Time-specified tolerance intervals and HBI were calculated using Matlab® R2007b (The Mathworks, Inc, Natick, Massachusetts, USA).

One-way analysis of variance was used to determine differences between the outcome groups and multiple post hoc comparisons were performed by Bonferroni t-test or Kruskal -Wallis test as appropriate. Receiver Operator Characteristics (ROC) curves were constructed to test the discriminate value of sphygmomanometry measurements, chronobiological blood pressure parameters and the HBI in predicting gestational hypertension, preeclampsia or both. We considered an area under the curve less than 0.75 as poor discriminative capacity. Between 0.75-0.90 was considered as fair and between 0.90-0.97 was considered as good. The optimal cut-off value was chosen using the maximum Youden index $(\text{sensitivity} + \text{specificity} - 1)$. Statistical calculations were performed with SPSS 16.0.2 (SPSS Inc. Chicago, Illinois, USA). The level of significance used was a $P$ value of less than 0.05.

Study size calculation was based on the test characteristics observed by Hermida et al. We expected that HBI could predict preeclampsia with a sensitivity and specificity

![Figure 2. Plot of the mean arterial pressure of a women with elevated hyperbaric index. The dashed line is the upper 90th percentile tolerance limit of the MAP. The curve starts at midsleep. The continuous line is the individual pressure. Marked area is the hyperbaric index.](image-url)
of 0.9 or higher. One hundred women with an incidence of preeclampsia of 7\% would be necessary to determine a statistically significant predictive effect with an \( \alpha \) equal to 0.05 and a \( \beta \) equal to 0.8, calculated by chi square test, tested two-sided. Exclusion of the first 90 women with uneventful pregnancies, who were selected for calculation of tolerance limits, was expected to increase the incidence of preeclampsia, which would elevate the power of our analysis. Sensitivity, specificity and area under the ROC curve are independent of incidence and therefore not influenced by this selection.

Table 1. Characteristics of the reference group and study population

<table>
<thead>
<tr>
<th>Variable</th>
<th>Reference population n=90</th>
<th>Normotensive women n=73</th>
<th>Gestational hypertension n=13</th>
<th>Preeclampsia n=15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>30.2 ± 3.7</td>
<td>30.5 ± 4.1</td>
<td>32.4 ± 2.9</td>
<td>29.1 ± 4.5</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>23.7 ± 3.2</td>
<td>23.8 ± 3.9</td>
<td>25.6 ± 3.0</td>
<td>27.3 ± 4.2*</td>
</tr>
<tr>
<td>High risk women (%)</td>
<td>0%</td>
<td>37%</td>
<td>31%</td>
<td>53%</td>
</tr>
<tr>
<td>History of preeclampsia (%)</td>
<td>0%</td>
<td>26%</td>
<td>23%</td>
<td>47%</td>
</tr>
<tr>
<td>Nulliparous (%)</td>
<td>100%</td>
<td>67%</td>
<td>69%</td>
<td>47%</td>
</tr>
<tr>
<td>SBP (mmHg)</td>
<td>104 ± 9</td>
<td>103 ± 10</td>
<td>110 ± 9</td>
<td>114 ± 15*</td>
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<tr>
<td>DBP (mmHg)</td>
<td>61 ± 7</td>
<td>61 ± 7</td>
<td>66 ± 7</td>
<td>69 ± 12*</td>
</tr>
<tr>
<td>MAP (mmHg)</td>
<td>76 ± 7</td>
<td>75 ± 7</td>
<td>81 ± 8‡</td>
<td>84 ± 13*</td>
</tr>
<tr>
<td>Sphygmonanometry</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ABPM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBP (mmHg)</td>
<td>110 ± 12</td>
<td>111 ± 7</td>
<td>114 ± 8</td>
<td>119 ± 14*</td>
</tr>
<tr>
<td>DBP (mmHg)</td>
<td>65 ± 4</td>
<td>65 ± 5</td>
<td>69 ± 6</td>
<td>72 ± 9*</td>
</tr>
<tr>
<td>MAP (mmHg)</td>
<td>80 ± 5</td>
<td>83 ± 5</td>
<td>86 ± 7</td>
<td>90 ± 10*</td>
</tr>
<tr>
<td>HBI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBP (mmH x hour)</td>
<td>4.1 ± 17</td>
<td>6.0 ± 22</td>
<td>4.9 ± 9</td>
<td>43.0 ± 54*†</td>
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<td>DBP (mmH x hour)</td>
<td>2.9 ± 9</td>
<td>8.0 ± 40</td>
<td>26.2 ± 54</td>
<td>46.7 ± 52*</td>
</tr>
<tr>
<td>MAP (mmH x hour)</td>
<td>2.8 ± 9</td>
<td>7.3 ± 36</td>
<td>20.6 ± 41</td>
<td>49.0 ± 57*</td>
</tr>
<tr>
<td>Dippers</td>
<td>56%</td>
<td>48%</td>
<td>54%</td>
<td>60%</td>
</tr>
<tr>
<td>Gestational age at delivery (weeks)</td>
<td>40.1 ± 1.1</td>
<td>38.7 ± 2.6</td>
<td>39.4 ± 1.6</td>
<td>34.6 ± 3.6*†</td>
</tr>
<tr>
<td>Delivery &lt; 37 weeks</td>
<td>0%</td>
<td>16.4%</td>
<td>7.7%</td>
<td>53.3%*†</td>
</tr>
<tr>
<td>Birthweight (g)</td>
<td>3616 ± 420</td>
<td>3122 ± 607</td>
<td>3316 ± 602</td>
<td>1959 ± 828*†</td>
</tr>
<tr>
<td>Small for gestational age (%)</td>
<td>0</td>
<td>24.7</td>
<td>30.8</td>
<td>73.3*†</td>
</tr>
</tbody>
</table>

Variables are expressed as mean ± SD or percentage. All measurements were in the first trimester of pregnancy except pregnancy outcome GH: gestational hypertension. PE: preeclampsia, SBP: systolic blood pressure, DBP: diastolic blood pressure, MAP: mean arterial pressure, Mean ABPM: mean 24h blood pressure measured with ambulatory blood pressure monitoring.

* uncomplicated vs. preeclampsia P<0.05, † gestational hypertension vs. preeclampsia P<0.05, ‡ uncomplicated vs. gestational hypertension P<0.05
RESULTS

Two hundred and nineteen women participated in the study. The mean gestational age at the beginning of the measurements was 9 weeks and 3 days (SD 6 days). Data of 28 women were not usable because of missing measurements or failure of the device. The main reason for missing measurements was discontinuation of wearing the device because women could not sleep with the device. After calculation of the time specified tolerance intervals with 90% confidence limits using measurements in the first 90 nulliparous women the data of the remaining 101 women were available for evaluation of the method. Patient characteristics of the study population are given in table 1. In the validation group 38 high risk women were included; 36 women had preeclampsia in a previous pregnancy, 1 woman had diabetes mellitus, and 1 woman had severe fetal growth retardation in a previous pregnancy. Seventy-three women had normal blood pressure throughout pregnancy, 13 developed gestational hypertension and 15 preeclampsia (Table 1).

Figure 3. (a) Sensitivity and specificity of sphygmanomanometry, ambulatory blood pressure monitoring and Hyperbaric index for predicting preeclampsia with 95% confidence interval. (b) Sensitivity and specificity of sphygmanomanometry, ABPM and HBI for predicting gestational hypertension with 95% CI. ABPM, ambulatory blood pressure monitoring; CI, confidence interval; DBP, diastolic blood pressure; HBI, hyperbaric index; MAP, mean arterial pressure; SBP, systolic blood pressure.
BMI, blood pressure measurements with sphygmomanometry and ABPM, and HBI differed significantly between normotensive women and women who developed preeclampsia (Table 1). Only sphygmomanometry MAP differed significantly between normotensive women and women who developed gestational hypertension. The ratio of day time and night time blood pressure and the percentage of ‘dippers’ were not significantly different between the groups.

Sphygmomanometry, mean ABPM and HBI had a comparable discriminative efficacy for gestational hypertension (sensitivity between 54 and 77%, specificity between 41 and 78%), see figure 3B. Only MAP and DBP had a statistically significant effect. The area under the curve for all parameters was between 0.57 and 0.66 which signifies poor test characteristics.

The results of the different measurement techniques for the prediction of preeclampsia did not vary largely (sensitivity between 53 and 73%, specificity between 86 and 95%), see figure 3A. All results reached statistical significance. HBI\textsubscript{MAX} had the best discrimination of preeclampsia with an area under the curve of 0.77 (95% CI 0.61-0.92), which can be classified as fair. The effect of all parameters was statistically significant and the area under the curve was between 0.71 and 0.77. Differences between the parameters were only small; in figure 4 and 5 ROC curves for the best parameter of each method are shown.

**Figure 4.** Receiver operator characteristic curve for the parameter with the highest area under the curve for prediction of preeclampsia for each method. ABPM, ambulatory blood pressure monitoring; HBI, hyperbaric index; MAP, mean arterial pressure; SBP, systolic blood pressure.

**Figure 5.** Receiver operator characteristic curve for the parameter with the highest area under the curve for prediction of preeclampsia for each method. ABPM, ambulatory blood pressure monitoring; HBI, hyperbaric index; MAP, mean arterial pressure; SBP, systolic blood pressure.
The optimum cut-off value for HBI was a $HBI_{\text{max}}$ of 17.6 mmHg x hour resulting in a sensitivity of 73% (95% CI 48-89%) and a specificity of 86% (95% CI 77-92%). The optimum cut-off value for sphygmomanometry was a SBP of 118 mmHg corresponding with a sensitivity of 60% (95% CI 36-81%) and a specificity of 92% (95% CI 84-96%).

**Discussion**

We could not reproduce the high predictive value of $HBI_{\text{max}}$ as observed by Hermida and co-workers, although we used a similar method for calculation of the reference and validation values.\(^{15-18}\)

We calculated the time-specified tolerance intervals with 90% confidence limits in our own population using measurements of 90 healthy nulliparous women with an uneventful pregnancy according to the method as described by Hermida et al.\(^{17;18}\) Group size for the reference population was similar to that used by Hermida et al. in their first trimester reference graph ($n=78$).\(^{26}\) Comparison of our reference graphs with those used by Hermida et al. demonstrates a slightly higher SBP and DBP in our reference data, while MAP was comparable. Differences could origin from an earlier gestational age in our study or from ethnic differences (Mediterranean vs. Northern Europe). It was therefore more appropriate to use reference values that are specific for our population and not those published by Hermida et al.\(^{26}\)

The HBI cut-off used by Hermida et al. was comparable with the cut-off calculated using ROC curve analysis (15 vs. 18 mmHg x hour) and using either value offered comparable predictive characteristics (sensitivity 73 vs. 73 %, specificity 85 vs. 86%). The difference in study outcome can, therefore, not be explained by differences in calculation of reference values.

Blood pressure was measured with the same blood pressure device as used by Hermida et al.\(^{16}\) The Spacelab 90207 is the only device for ABPM that was validated extensively in pregnant women. In three studies the device passed the Association for the Advancement of Medical Instrumentation (AAMI) criteria. However, following British Hypertension Society (BHS) criteria, these studies graded the device as B/B, A/C and B/C respectively.\(^{27-29}\) We decided to use the Spacelab, notwithstanding these conflicting results, as it was used by the group whose method we wanted to validate and as no other ABPM device was described with better characteristics for pregnant women at the beginning of our study. In our study, all nulliparous women and all women with high obstetric risk, who visited our outpatient clinic for antenatal care early enough for participation, were invited for the study. However, the method for recruitment in the study of Hermida, the percentage of
nulliparous or high-risk women and precise gestational age when women were measured in the first trimester was not described.

Participants in the study by Hermida et al. were examined at 4-week intervals and part of the participants contributed twice to the reference graph or the validation study. We only measured women once between 8 and 11 weeks of pregnancy. Because blood pressure lowers in the first half of pregnancy a close range of time of the measurements should only improve predictive characteristics. Although population differences or selection bias could explain part of the differences in outcome between the study by Hermida et al. and our study, we have insufficient data to support this supposition.

One other study investigated chronobiological analysis in the first trimester of pregnancy for prediction of gestational hypertension or preeclampsia. This study included 104 women with moderate to high risk for hypertensive complications of pregnancy. Most women had a history of preeclampsia and also twin pregnancies were allowed. Participants were examined between 8 and 16 weeks in a hospital-based research setting. The best predictive parameter in the 8-16 week period was systolic HBI at a cut-off of 5 mmHg/hour with a sensitivity of 80% and a specificity of 77%. The method for calculating HBI differed from the method used by Hermida et al. and in our study.

Blood pressure is widely used for screening in pregnancy for hypertensive disorders but the results, as a predictive tool early in pregnancy, are conflicting. A recent systematic review of literature showed poor predictive accuracy for preeclampsia by measurement of SBP, DBP, MAP, and increase of blood pressure with the best results for a MAP of at least 90 mmHg, LR+ of 3.5 (95% CI 2.0-5.0) and LR- of 0.46 (95% CI 0.16-0.75). In six of the 34 included studies blood pressure measurement was performed in the first trimester. The test characteristics of these studies were comparable to the remaining studies. The two studies targeted at a high risk population had similar characteristics as the remaining studies. Differences between nulliparous and multiparous women were not assessed. These findings supported that the combination of high risk women and low risk nulliparous women in our study is valid. The outcome of our study is comparable with findings in this meta-analysis. Although a more sophisticated measurement technique as proposed by Hermida et al. results in slightly better characteristics than obtained in most studies, the extremely high sensitivity and specificity as reported should be considered as an overestimation.

A 48-h ambulatory blood pressure measurement is generally considered as a burden. In our study, 13% of the registrations were inadequate for analysis, sometimes because of device failure but mostly because of missing measurements for a couple of hours. These women discontinued wearing the device because they perceived this as too much of a strain. Our number of dropouts is comparable to a study which investigated
patient satisfaction with the Spacelab 90207 in pregnant women. Sleep disturbance was the main reason for noncompliance in this study, which was similar in our study. Sphygmomanometry measurements are easy to perform and take only a couple of minutes. The predictive efficacy was comparable with the hyperbaric index in our study. It should be noted that auscultatory blood pressure measurement was performed according to a standardized procedure, after sufficient rest in supine position and by averaging three consecutive measurements. This differs from standard outpatient clinic procedure, explaining better predictive characteristics than observed in most studies. DBP is slightly lower in supine position than in sitting position, while SBP is similar. As this difference is independent of blood pressure level or body mass index, and as we used ROC curve analysis for determining the optimum cut-off in our population, this difference in position could not have influenced our results.

**CONCLUSION**

The accuracy of first trimester prediction of preeclampsia or gestational hypertension by blood pressure measurement alone is insufficient for clinical use. Although blood pressure is higher early in pregnancy in women who will develop preeclampsia standardized sphygmomanometry, mean ABPM and HBI calculation from 48-h ABPM had a comparable, restricted predictive efficacy. We could not confirm the high predictability of the hyperbaric index using 48-h ABPM for preeclampsia or gestational hypertension as observed by Hermida et al.
Reference List


