The predictive value of estimated pulse wave velocity combined with BMI for newly diagnosed diabetes

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Research Article

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Abstract

Purpose

ePWV and BMI are closely related to the prediction of new-onset diabetes. The aim of this study was to evaluate the impact and predictive value of the combination of estimate pulse wave velocity (ePWV) and body mass index (BMI) on new-onset diabetic patients.

Methods

A secondary analysis of a cohort study conducted by rich health care was performed with a total of 211833 eligible subjects enrolled. Logistic regression analysis was used to identify factors influencing the occurrence of diabetes, and ROC curve analysis was used to evaluate the predictive value of ePWV, BMI, and their combination on new-onset diabetes.

Results

During a mean follow-up period of 3.12 years, 3000 men (1.41%) and 1174 women (0.55%) were diagnosed with diabetes. Logistic regression analysis showed that BMI, triglycerides, alanine aminotransferase, blood urea nitrogen, creatinine clearance rate, ePWV, and history of diabetes in the family were high-risk factors for new-onset diabetes. Compared with using ePWV or BMI alone, the combined ePWV and BMI had a higher area under the receiver operating characteristic curve of 0.822.

Conclusion

The elevation of ePWV and BMI levels is an independent risk factor for new-onset diabetes, and the combination of ePWV and BMI can better predict new-onset diabetes compared to using either indicator alone.

Background

Diabetes is a metabolic disorder caused by abnormal glucose metabolism and is one of the most common chronic diseases in the world[1]. According to the latest epidemiological survey, the prevalence rate is 6059 cases per 100,000 people, and the burden of diabetes is increasing globally. It is estimated that by 2030, the incidence of type 2 diabetes worldwide will increase to 7079 cases per 100,000 people[2, 3]. As the disease progresses, it can cause long-term disability and serious damage to quality of life. Diabetes can mediate multi-organ damage, leading to complications such as cardiovascular events, cerebrovascular diseases, kidney diseases, and eye diseases[4, 5]. Therefore, given the enormous burden of diabetes patients, it is of great significance to identify high-risk populations for diabetes through simple and effective methods.

Genetics, diet, unhealthy lifestyle, and environment can all lead to diabetes. Among them, obesity is closely related to diabetes. Multiple studies have shown that BMI, as an indicator of obesity, can
effectively predict diabetes [6–8]. Additionally, research has shown that increased arterial stiffness is closely related to high blood sugar, hyperinsulinemia, and abnormal glucose tolerance [9]. ePWV, as a new indicator that can better reflect arterial stiffness, is different from PWV, which requires complex operations and expensive prices. Previous studies have shown that ePWV is closely related to cognitive impairment, stroke, cardiovascular events, and hypertension [10–14]. However, there is currently little research on its predictive value for diabetes. In order to more simply and effectively identify new-onset diabetes, this study aims to evaluate the predictive value of the combination of ePWV and BMI for new-onset diabetic patients.

Methods

Study design and data source

This study is a secondary analysis of the cohort study conducted by Rich Healthcare, the design of which has been detailed elsewhere[15]. In brief, the Rich Healthcare cohort study recruited 685,277 adult participants from 11 cities in China who underwent health examinations between 2011 and 2016. The project aims to promote the health of the Chinese population and evaluate diabetes and its risk factors through health checks and follow-up of the general population. The datasets generated and/or analysed during the current study are available in the Dryad repository, http://datadryad.org/withthedoi:10.5061/dryad.ft8750v. According to the service terms of the database, researchers can freely use public data for subsequent analysis to maximize the usefulness of the data. As the anonymity of the data and research ethics have been approved in previous studies, this study does not require re-application. This study is a post-hoc analysis based on previous research. The exclusion criteria for study subjects are as follows: (1) subjects diagnosed with diabetes at baseline interview; (2) diabetes status unclear during follow-up; (3) subjects with less than 2 years of follow-up time; (4) incomplete or extreme values for gender, BMI, FPG and blood lipid parameters; (5) subjects without height, weight, blood pressure measurement information; and (6) subjects who did not participate in this study for unknown reasons. In this study, a total of 211,833 eligible subjects were ultimately analyzed.

Data collection

All study subjects were required to complete a standardized questionnaire, which includes demographic characteristics and physical examination results such as age, family history of diabetes, gender, blood pressure, height, weight, and smoking/drinking status. Weight and height were measured indoors with the subject not wearing shoes and only wearing lightweight clothing. Blood pressure was measured with a standard mercury sphygmomanometer in a quiet environment. Fasting venous blood was collected by trained personnel and analyzed using an automated analyzer (Beckman 5800) in a standard laboratory, where plasma glucose levels were determined using the glucose oxidase method.

Definition and calculation
The start time of follow-up is considered to be after the subject's first clinical diabetes assessment, and the end point of follow-up is the occurrence of a new diabetes event. Follow-up primarily takes place at the examination center with a frequency of once a year. Diabetes diagnosis was defined as self-reported history of diabetes or a measured FPG value $\geq 7.00$ mmol/L during follow-up[16]. For those who have already been diagnosed with diabetes, researchers reviewed their blood glucose levels on the day of diagnosis or at the last visit.

Calculation of Indicators.

The ePWV calculation mainly involves age and blood pressure, and the ePWV formula is: $ePWV = 9.587 - 0.402 \times \text{age} + 4.560 \times 10^{-3} \times \text{age}^2 - 2.621 \times 10^{-5} \times \text{age}^2 \times \text{MBP} + 3.176 \times 10^{-3} \times \text{age} \times \text{MBP} - 1.832 \times 10^{-2} \times \text{MBP}[17, 18]$. The BMI is calculated as weight divided by height squared.

**Statistical analysis**

Statistical analysis was carried out using R software version 4.2 and IBM SPSS Statistics version 23.0. Continuous variables were presented as mean ± standard deviation (SD), while categorical variables were presented as absolute values and percentages. T-test and one-way analysis of variance (ANOVA) were used for parametric comparisons, while Mann-Whitney U and Kruskal-Wallis tests were used for non-parametric comparisons. Chi-square test or Fisher's exact test were used to compare categorical variables as needed. Multivariable logistic models included significant variables at a $P < 0.1$ level in univariate analyses. Receiver operating characteristic (ROC) curves were used to calculate the sensitivity and specificity of ePWV, BMI, and ePWV combined with BMI levels. The variables for model selection included all potential confounding variables. All hypothesis tests were two-tailed, and a $P$-value of $< 0.05$ was considered statistically significant.

**Results**

Anthropometric and biochemical characteristics

After excluding subjects who did not meet the criteria, a total of 211,833 eligible subjects were analyzed, including 116,123 men and 95,710 women, with a mean age of $42.10 \pm 12.65$ years, a mean ePWV of $7.47 \pm 1.72$ (m/s), and a mean BMI of $23.24 \pm 3.34$ (Kg/m2). According to whether they were diagnosed with diabetes at the end of follow-up, they were divided into the diabetes group and non-diabetes group. The anthropometric and biochemical characteristics of the patients are shown in Table 1. It can be seen that in this study, new-onset diabetes patients were more likely to be male, older, taller and heavier, with higher BMI, SBP, DBP, and were more likely to smoke, drink alcohol, and have a family history of diabetes. In terms of hematological indicators, they had higher levels of Cholesterol, Triglyceride, LDL, ALT, AST, BUN, CCR, MAP, ePWV, and lower levels of HDL-c (as shown in Tables 1).
Table 1
Baseline characteristics of the study population.

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>No-diabetes</th>
<th>Diabetes</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>211833</td>
<td>207659</td>
<td>4174</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>42.10 (12.65)</td>
<td>41.84 (12.51)</td>
<td>54.73 (13.16)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Female(%)</td>
<td>95710 (45.2)</td>
<td>94536 (45.5)</td>
<td>1174 (28.1)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Height(cm)</td>
<td>166.43 (8.33)</td>
<td>166.42 (8.32)</td>
<td>166.87 (8.45)</td>
<td>0.001</td>
</tr>
<tr>
<td>Weight(kg)</td>
<td>64.68 (12.22)</td>
<td>64.51 (12.14)</td>
<td>73.23 (13.14)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>BMI(kg/m²)</td>
<td>23.24 (3.34)</td>
<td>23.18 (3.31)</td>
<td>26.17 (3.48)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>SBP(mmHg)</td>
<td>119.06 (16.38)</td>
<td>118.81 (16.23)</td>
<td>131.56 (18.74)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>DBP(mmHg)</td>
<td>74.18 (10.81)</td>
<td>74.05 (10.75)</td>
<td>80.67 (11.86)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Cholesterol(mmol/L)</td>
<td>4.71 (0.90)</td>
<td>4.70 (0.90)</td>
<td>5.05 (0.95)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Triglyceride(mmol/L)</td>
<td>1.34 (1.03)</td>
<td>1.32 (1.01)</td>
<td>2.09 (1.50)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>HDL-c(mmol/L)</td>
<td>1.37 (0.31)</td>
<td>1.37 (0.31)</td>
<td>1.29 (0.34)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>LDL(mmol/L)</td>
<td>2.77 (0.68)</td>
<td>2.77 (0.68)</td>
<td>2.90 (0.70)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>ALT(U/L)</td>
<td>23.95 (22.13)</td>
<td>23.73 (21.90)</td>
<td>35.28 (29.18)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>AST(U/L)</td>
<td>24.08 (12.36)</td>
<td>23.98 (12.30)</td>
<td>29.11 (14.17)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>BUN(mmol/L)</td>
<td>4.66 (1.19)</td>
<td>4.65 (1.18)</td>
<td>5.01 (1.28)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>CCR(umol/L)</td>
<td>70.07 (15.80)</td>
<td>70.01 (15.80)</td>
<td>72.73 (15.82)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Smoking.status(%)</td>
<td></td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>current smoker</td>
<td>12075 (5.7)</td>
<td>11660 (5.6)</td>
<td>415 (9.9)</td>
<td></td>
</tr>
<tr>
<td>ever smoker</td>
<td>2559 (1.2)</td>
<td>2483 (1.2)</td>
<td>76 (1.8)</td>
<td></td>
</tr>
<tr>
<td>never smoker</td>
<td>45596 (21.5)</td>
<td>44915 (21.6)</td>
<td>681 (16.3)</td>
<td></td>
</tr>
<tr>
<td>Drinking status(%)</td>
<td></td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>current drinker</td>
<td>1351 (0.6)</td>
<td>1302 (0.6)</td>
<td>49 (1.2)</td>
<td></td>
</tr>
<tr>
<td>ever drinker</td>
<td>8956 (4.2)</td>
<td>8769 (4.2)</td>
<td>187 (4.5)</td>
<td></td>
</tr>
<tr>
<td>never drinker</td>
<td>49923 (23.6)</td>
<td>48987 (23.6)</td>
<td>936 (22.4)</td>
<td></td>
</tr>
<tr>
<td>DM family histroy (%)</td>
<td>4344 (2.1)</td>
<td>4173 (2.0)</td>
<td>171 (4.1)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>MAP</td>
<td>92.13 (12.03)</td>
<td>91.95 (11.94)</td>
<td>101.03 (13.06)</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>
Abbreviations: BMI, Body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; HDL-c, high-density lipid cholesterol; LDL, low-density lipid cholesterol; ALT, alanine aminotransferase; AST, aspartate aminotransferase; BUN, blood urea nitrogen; CCR, creatinine clearance; ePWV, estimated pulse wave velocity.

Multivariable logistic regression analysis of risk factors for DM

To investigate the correlation between various indicators and the incidence of new-onset diabetes, multivariable logistic regression was performed with DM occurrence as the dependent variable and various relevant indicators as independent variables. The results showed that BMI, Triglyceride, ALT, BUN, CCR, ePWV, and a family history of diabetes were high-risk factors for new-onset diabetes (Table 2). The OR (95%CI) for BMI was 1.132 (1.087–1.178), and the OR (95%CI) for ePWV was 1.573 (1.464–1.689).

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>No-diabetes</th>
<th>Diabetes</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>ePWV (m/s)</td>
<td>7.47 (1.72)</td>
<td>7.43 (1.69)</td>
<td>9.36 (2.08)</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>
Table 2
Logistic regression analysis for univariate and multivariate analysis.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Univariable</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>OR</td>
<td>CI (95%)</td>
<td>p</td>
<td>OR</td>
<td>CI (95%)</td>
<td>p</td>
<td></td>
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<tr>
<td>Sex</td>
<td>0.468</td>
<td>0.437–0.501</td>
<td>&lt; 0.001</td>
<td>0.652</td>
<td>0.415–1.015</td>
<td>0.060</td>
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<tr>
<td>BMI</td>
<td>1.248</td>
<td>1.238–1.258</td>
<td>&lt; 0.001</td>
<td>1.132</td>
<td>1.087–1.178</td>
<td>&lt; 0.001</td>
<td></td>
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<tr>
<td>Cholesterol</td>
<td>1.458</td>
<td>1.415–1.502</td>
<td>&lt; 0.001</td>
<td>1.195</td>
<td>0.869–1.629</td>
<td>0.268</td>
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</tr>
<tr>
<td>Triglyceride</td>
<td>1.361</td>
<td>1.339–1.383</td>
<td>&lt; 0.001</td>
<td>1.140</td>
<td>1.031–1.257</td>
<td>0.010</td>
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<tr>
<td>HDL-c</td>
<td>0.392</td>
<td>0.343–0.447</td>
<td>&lt; 0.001</td>
<td>0.822</td>
<td>0.491–1.343</td>
<td>0.453</td>
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<tr>
<td>LDL</td>
<td>1.312</td>
<td>1.245–1.381</td>
<td>&lt; 0.001</td>
<td>0.788</td>
<td>0.546–1.144</td>
<td>0.206</td>
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<tr>
<td>ALT</td>
<td>1.010</td>
<td>1.009–1.010</td>
<td>&lt; 0.001</td>
<td>1.010</td>
<td>1.001–1.019</td>
<td>0.023</td>
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<tr>
<td>AST</td>
<td>1.012</td>
<td>1.010–1.014</td>
<td>&lt; 0.001</td>
<td>0.994</td>
<td>0.974–1.012</td>
<td>0.526</td>
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<tr>
<td>BUN</td>
<td>1.253</td>
<td>1.224–1.284</td>
<td>&lt; 0.001</td>
<td>1.200</td>
<td>1.078–1.334</td>
<td>&lt; 0.001</td>
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<tr>
<td>CCR</td>
<td>1.008</td>
<td>1.006–1.010</td>
<td>&lt; 0.001</td>
<td>0.978</td>
<td>0.966–0.989</td>
<td>&lt; 0.001</td>
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<tr>
<td>Current smoker</td>
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<tr>
<td>Ever smoker</td>
<td>0.860</td>
<td>0.666–1.095</td>
<td>0.234</td>
<td>1.227</td>
<td>0.710–2.026</td>
<td>0.442</td>
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<tr>
<td>Never smoker</td>
<td>0.426</td>
<td>0.377–0.482</td>
<td>&lt; 0.001</td>
<td>0.601</td>
<td>0.442–0.817</td>
<td>0.001</td>
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<tr>
<td>Current drinker</td>
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<tr>
<td>Ever drinker</td>
<td>0.567</td>
<td>0.415–0.788</td>
<td>&lt; 0.001</td>
<td>0.828</td>
<td>0.468–1.542</td>
<td>0.533</td>
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</tr>
<tr>
<td>Never drinker</td>
<td>0.508</td>
<td>0.383–0.689</td>
<td>&lt; 0.001</td>
<td>0.881</td>
<td>0.522–1.584</td>
<td>0.653</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>DM family history</td>
<td>2.083</td>
<td>1.776–2.427</td>
<td>&lt; 0.001</td>
<td>2.604</td>
<td>1.697–3.873</td>
<td>&lt; 0.001</td>
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<tr>
<td>ePWV</td>
<td>1.480</td>
<td>1.462–1.497</td>
<td>&lt; 0.001</td>
<td>1.573</td>
<td>1.464–1.689</td>
<td>&lt; 0.001</td>
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</tr>
</tbody>
</table>

Abbreviations: BMI, Body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; HDL-c, high-density lipid cholesterol; LDL, low-density lipid cholesterol; ALT, alanine aminotransferase; AST, aspartate aminotransferase; BUN, blood urea nitrogen; CCR, creatinine clearance; ePWV, estimated pulse wave velocity.

ROC curve analysis

As shown in Fig. 1, the ability of ePWV, BMI, and their combination to predict new-onset diabetes is shown in the graph. ROC curves were calculated to demonstrate the ability of ePWV, BMI, and the combination of both factors to distinguish DM from non-DM. The AUC was calculated to evaluate the
discriminatory performance of each biomarker for DM. Pairwise comparisons of ROC curves using the DeLong method indicated that neither the ePWV model (AUC: 0.789; 95% CI: 0.783–0.795; P < 0.001) nor the BMI model (AUC: 0.740; 95% CI: 0.733–0.747; P < 0.001) performed as well as the combined ePWV and BMI model (AUC: 0.822; 95% CI: 0.817–0.828; P < 0.001).

Discussion

In this study, we investigated whether the combination of ePWV and BMI has good predictive value for diabetes risk in a large sample cohort study of the Chinese population. After adjusting for confounding factors that may contribute to the risk of diabetes through multivariable logistic regression, we found a significant positive correlation between ePWV/BMI and new-onset diabetes (OR (95% CI) for BMI was 1.132 (1.087-1.178), and the OR (95% CI) for ePWV was 1.573 (1.464-1.689)). Moreover, by using ROC diagnostic tests, we found that the combined value of the two factors is higher than the value of either alone, indicating good diagnostic/predictive value.

The incidence of diabetes and its complications, such as cardiovascular and renal disease, is increasing, which is a huge burden worldwide. Although the risk of diabetes-related mortality has decreased in recent years, the relative risk of adverse cardiovascular events in diabetic patients remains high [19,20]. A meta-analysis showed that diabetes can increase the risk of various cardiovascular diseases by about two-fold, independent of other conventional risk factors [21]. Therefore, it is still urgent to explore more effective methods for early screening and diagnosis of diabetes patients in order to help implement targeted and proactive prevention strategies.

Increased arterial stiffness in diabetic patients is believed to be related to quantitative and qualitative changes in arterial wall elastic protein and collagen protein[22]. The results of related studies indicate that this change may be caused by factors other than short-term hyperglycemia and hyperinsulinemia, such as carbonyl and oxidative stress, chronic low-grade inflammation, and endothelial dysfunction, including long-term hyperglycemia and formation of advanced glycation end-products [23-26]. Currently, a large body of research shows that diabetes can lead to an increase in arterial stiffness [27,28], and the latest research has found that there may be bidirectionality between them. After adjusting for potential confounding factors, for the third quartile of c-fPWV, the risk ratios of diabetes were 1.00 (reference), 1.83 (95% CI 0.88-3.8), and 3.24 (95% CI 1.51-6.97) (P for trend = 0.002) [29]. Weber discussed the rationality of the bidirectional relationship between arterial stiffness and the development of diabetes, and received support from various studies [30]. Eiji Kimoto found that diabetes had a significant impact on hcPWV, hbPWV, and faPWV through grouped comparisons of healthy individuals and diabetic patients. Type 2 diabetes has different effects on central and peripheral arterial stiffness, and diabetes and age have a greater impact on carotid-femoral PWV and heart-groin PWV than on brachial-ankle and heart-arm PWV [26]. Although these studies used different indicators of arterial stiffness, such as central arterial pressure index, peripheral arterial pressure, and augmentation index, they came to similar conclusions that increased arterial stiffness is associated with a higher risk of developing diabetes. We also found similar results using non-invasive ePWV as a reliable indicator to evaluate arterial stiffness.
BMI can reflect the accumulation of body fat and is closely related to the risk of developing diabetes, which is a recognized risk factor for glycemic dysregulation. In a study by Graham et al., which followed 114,824 women for 14 years and adjusted for age, BMI was the primary predictor of diabetes risk, and the risk increased with increasing BMI, even among women of average weight (body mass index, 24.0 kg/m\(^2\))[31]. Another study of middle-aged and elderly Americans demonstrated that weight gain in later life (after age 50 or 65) was an important risk factor for diabetes in older adults. Although the risk associated with obesity appears to decrease with age, among participants aged 75 and older, the highest BMI individuals still have twice the risk of developing diabetes compared to those with the lowest BMI[32]. A study from Japan also indicated that long-term increases in BMI during adulthood are important predictors of diabetes development, independent of the achieved weight status, and even weight gain within the normal weight range may increase the risk of developing diabetes[33]. Similarly, our study also found a significant correlation between BMI and diabetes risk.

The ePWV and BMI indicators can respectively reflect the health status of the cardiovascular system and the accumulation of body fat, and their combined use can more comprehensively evaluate the risk of developing diabetes in individuals. Furthermore, the combination of these two biomarkers has a higher predictive value for newly diagnosed DM than the use of either one alone. Therefore, we recommend the combined use of ePWV and BMI indicators for diabetes risk assessment in clinical practice to improve prediction accuracy. This is important for identifying high-risk individuals for diabetes at an early stage and optimizing treatment strategies.

However, there are several limitations that should be considered in our study. (1) The present study did not classify the type of diabetes. However, as type 2 diabetes accounts for approximately 95% of all cases of diabetes, the results of our study may more accurately represent type 2 diabetes. (2) The diagnosis of diabetes in this study relied on self-report during follow-up or FPG >7.0 mmol/L, which may lead to an underestimation of the true prevalence of diabetes.

**Conclusion**

In conclusion, we found that elevated ePWV and BMI levels are independent risk factors for newly diagnosed diabetes. The combination of ePWV and BMI can better predict the onset of diabetes compared to either one alone. This study provides simple and practical reference indicators for clinical doctors to predict, identify, and screen high-risk patients for diabetes, and make correct clinical decisions to plan and initiate the most appropriate disease management in a timely manner.

**Abbreviations**

- ePWV: estimated pulse wave velocity
- PWV: pulse wave velocity
- cfPWV: carotid-femoral pulse wave velocity
Declarations

Ethics approval and consent to participate

Due to the anonymity of the data, research ethics has been approved in previous studies, so there was no need to reapply in this study.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Availability of data and materials

Data can be downloaded from ‘DATADRYAD’ database (www.Datadryad.org).

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Authors' contributions

Chengwen Chen and CW designed this study. WB, Chunwei Chen and Chengwen Chen conducted data cleaning and statistical analysis. WB, WHC, XL made the result interpretation. WB, Chengwen Chen and Chunwei Chen participated in the discussion; Chengwen Chen drafted the manuscript, and CW revised it. All authors read and approved the final manuscript.

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References


Figure 1

ROC curve of diabetes predicted by BMI, ePWV and combined index. The receiver operating characteristic curve of BMI combined with ePWV was 0.822, which was higher than BMI or ePWV alone.

Abbreviations: ROC, receiver operating characteristic; AUC, area under the ROC curve; BMI, Body mass index; ePWV, estimated pulse wave velocity.