AUCTORES
Globalize your Research

Cardiology Research and Reports
Natsuko Mizutani *

Open Access

Research Article

Validation of a Fingertip Continuous Blood Pressure Monitor and an Awareness Survey on Blood Pressure Measurement

Natsuko Mizutani [1]*, Yukie Enomoto [2], Hiroteru Okamoto [3], Satoshi Nishizawa [4], Serina Murakami [1], Ai Asahara [1], Haruka Inoue [1], Kirika Yamamoto [1], and Yu-Ching Lin [5]

[1]Department of Medical Technology, Faculty of Health Sciences, Kyorin University, Japan.

[2]Department of Rehabilitation, Faculty of Health Sciences, Kyorin University, Japan.

[3]Department of Health and Welfare, Faculty of Health Sciences, Kyorin University, Japan.

[4]Department of Rehabilitation, Faculty of Medical and Health Sciences, Tohoku Bunka. Gakuen University, Japan.

[5]Cardio Ring Technologies, Inc. San Jose, CA 95134, USA.

***Corresponding Author:** Natsuko Mizutani, 181-8612, Shimorenjyaku 5-4-1, Mitaka-shi, Tokyo, Japan.

Received date: November 03, 2025; Accepted date: November 17, 2025; Published date: December 03, 2025

Citation: Natsuko Mizutani, Yukie Enomoto, Hiroteru Okamoto, Satoshi Nishizawa, Serina Murakami, et al, (2025), Validation of a Fingertip Continuous Blood Pressure Monitor and an Awareness Survey on Blood Pressure Measurement, *Cardiology Research and Reports*, 7(7); **DOI:10.31579/2692-9759/177**

Abstract

Background: Continuous blood pressure (BP) monitoring is not widely available in Japan, and conventional measurements obtained at clinics or during health checkups do not reflect diurnal variation. Early detection of masked hypertension and abnormal BP fluctuations requires a simple and noninvasive device capable of continuous monitoring.

Aim: This study aimed to evaluate the accuracy and feasibility of the ArteVu fingertip BP monitor—a new device developed in Taiwan that allows continuous, cuff-free measurement—and to assess users' perceptions regarding self-monitoring of BP.

Methods: Healthy volunteers aged ≥50 years participating in a university health exercise class were enrolled. Resting BP was measured using a validated home BP monitor (Omron). Participants then performed stretching exercises for approximately 1.5 hours, after which BP was measured simultaneously using ArteVu (right finger; continuous 5-min recording) and Omron (left arm). A second measurement was taken after 5 minutes of rest. Agreement between devices was evaluated using Bland–Altman analysis with bootstrap resampling. A questionnaire assessed comfort and awareness related to BP self-monitoring.

Results: Thirteen participants (mean age 77.4 ± 7.3 years) were included. Bland–Altman analysis showed a mean error (±SD) of 3.6 ± 12.9 mmHg for systolic BP, −2.7 ± 8.1 mmHg for diastolic BP, and 0.3 ± 0.94 bpm for heart rate. ArteVu generally agreed with the reference device, although greater variability was observed immediately after exercise. Continuous waveform analysis identified one participant with an abnormal pulse pattern, consistent with self-reported high BP.

Conclusion: ArteVu demonstrated acceptable agreement with a validated home BP device and provided useful continuous waveform information. With further improvements in signal stability and miniaturization, ArteVu has the potential to support preventive care and promote self-monitoring of BP among older adults.

Keywords: continuous blood pressure monitoring; fingertip blood pressure device; Bland–Altman analysis; pulse waveform; blood pressure self-monitoring; hypertension awareness

Introduction

Blood pressure (BP) measurement in Japan is typically performed during health checkups, at medical institutions, or at home. However, such measurements reflect only a single time point and cannot capture BP fluctuations occurring throughout the day. As a result, individuals with masked hypertension or early morning BP elevation may remain undetected. In a primary care–based study by Martinez et al., the frequency of white-coat hypertension among patients with mild to moderate hypertension was reported to be 39% when daytime ambulatory BP ≤135/85 mmHg was used

as the reference [1]. Furthermore, BP can vary according to time of day and environmental conditions, and in some individuals, BP is higher or lower in the early morning, which has been associated with increased cardiovascular risk [2,3].

Although home BP monitoring is recommended, not all health-conscious individuals are able to control or regularly measure their BP. Continuous or repeated measurements over 24 hours have been shown to be important for detecting morning surges, nocturnal hypertension, and BP variability, all of which are implicated in cardiovascular outcomes [4–7]. Ambulatory BP monitoring (ABPM) can capture such patterns; however, it requires physician supervision and is not widely used among people who do not routinely visit clinics.

The ArteVu fingertip BP monitor, developed in Taiwan, enables continuous estimation of BP via a finger-mounted sensor (Figure 1). The device is designed to be noninvasive and suitable for long-term recording. However, clinical validation of its performance remains limited. Therefore, this study aimed to (1) evaluate the accuracy of ArteVu compared with a validated home BP monitor in healthy older adults and (2) assess user perceptions and attitudes toward BP self-monitoring through a questionnaire survey.

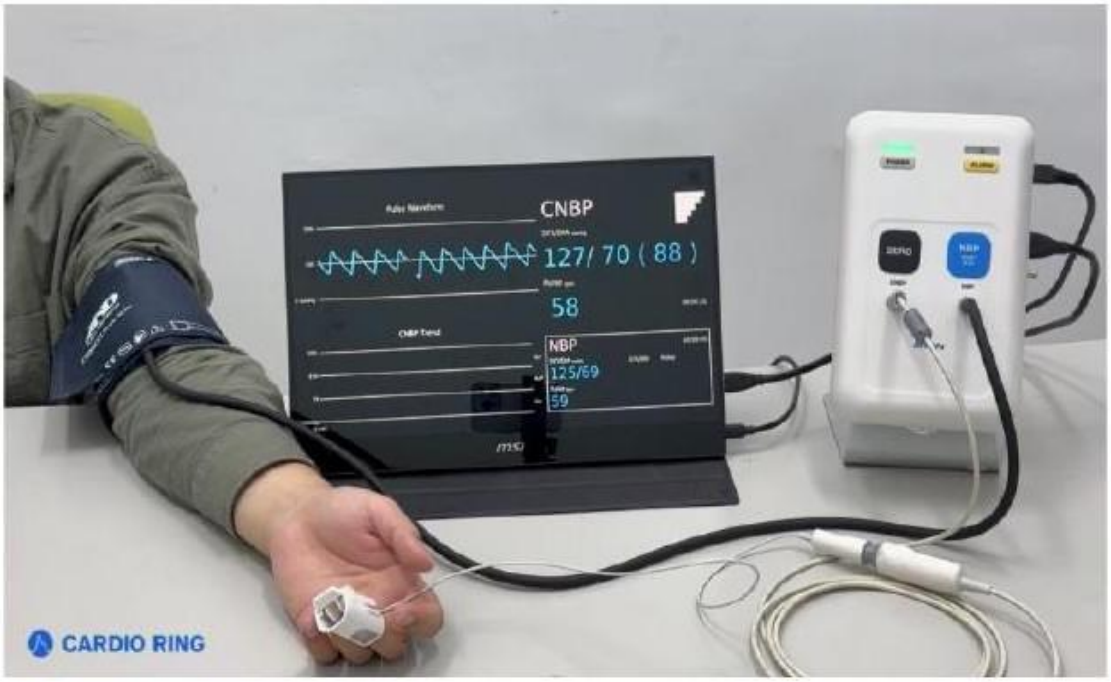


Figure 1: Finger-Tip Blood Pressure Monitoring Device.

This device continuously measures blood pressure and pulse waves using a non-invasive mechanical sensor worn on the fingertip. It requires no cuff and enables long-term monitoring. While the current model requires initial calibration using an upper-arm cuff, future models are expected to utilize a fully fingertip-based measurement system.

Materials and Methods

Participants

Individuals aged 50–90 years attending a regularly scheduled stretching exercise class at Kyorin University were invited to participate. Participants were informed about the purpose and procedures of the study, and those who agreed provided written or verbal consent in accordance with institutional ethical approval. Individuals who were unable to complete the exercise session or follow the measurement procedures were excluded.

Measurement procedure

Resting BP was first measured using a validated upper-arm home BP monitor (Omron). Participants then performed a stretching program for approximately 1.5 hours under the guidance of an experienced instructor. Immediately after completion of the exercise, BP was measured simultaneously using the ArteVu fingertip monitor and the Omron device. ArteVu was attached to the right index finger and recorded continuous waveforms for 5 minutes, whereas the Omron monitor measured BP on the left upper arm at a single time point. After an additional 5 minutes of rest, paired ArteVu and Omron measurements were obtained again. ArteVu waveform data were stored and later used for qualitative pulse morphology analysis.

Questionnaire

Following the BP measurements, participants completed a questionnaire that assessed comfort while wearing the device (pain, pressure, dampness, and overall discomfort), ease of positioning the fingertip sensor, history of high or low BP as informed by a physician, ownership and use of a home BP monitor, and willingness to use or purchase a compact fingertip BP monitor in the future.

Statistical analysis

To minimize the influence of individual variability in this small sample, bootstrap resampling was performed to generate 30 datasets with the same sample size. Agreement between ArteVu and the Omron device was evaluated using Bland–Altman analysis in accordance with ISO 81060-2 criteria. The normality of measurement differences was assessed using the Shapiro–Wilk test. Mean difference, standard deviation (SD), and 95% limits of agreement were calculated for systolic BP (SBP), diastolic BP (DBP), and heart rate (HR). Linear regression analysis was used to construct correlation plots between the two devices; however, correlation was not used as the primary measure of accuracy. All statistical analyses were conducted using SPSS (IBM Corp., Armonk, NY, USA), and a two-sided p value <0.05 was considered statistically significant.

Results

A total of 13 participants (8 men and 5 women; mean age 77.4 ± 7.3 years, range 66–92 years) completed all measurements and the questionnaire. Table 1 summarizes their demographic characteristics. More than half of the participants (53.8%) had a history of hypertension, whereas 46.2% reported no chronic medical conditions.

Characteristic	Mean ± SD	Minimum–Maximum
Age (years)	77.4 ± 7.3	66–92
Height (cm)	163.7 ± 10.0	148–178
Weight (kg)	59.6 ± 10.9	39–80
BMI	22.1 ± 2.3	18.1–25.3

Section 1.01 Sex (%)

Category	%
Male	61.5
Female	38.4

Section 1.02 History of current illness (%)

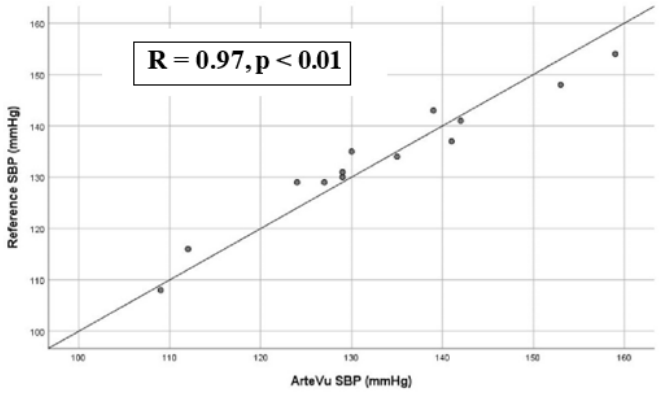
Condition	%
Hypertension	53.8
No special notes	46.2

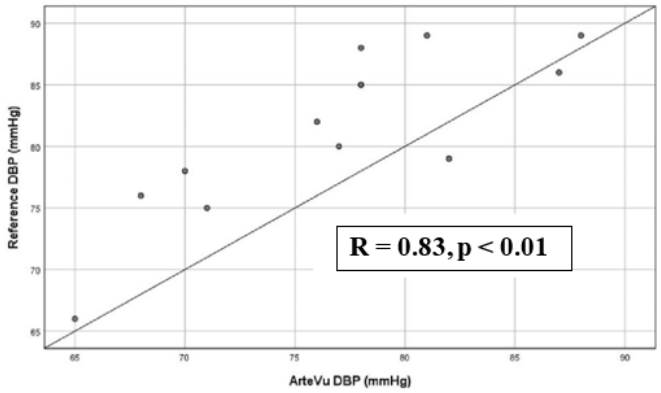
Table 1: Characteristics of participants (N = 13).

Resting BP was measured using the Omron home BP monitor prior to the exercise session. Resting SBP, DBP, and HR values varied across individuals, reflecting heterogeneity in cardiovascular status in this older population. ArteVu recordings at rest captured clear pulse waveforms in all participants, confirming good finger–sensor contact during the baseline phase.

Following the 1.5-hour stretching session, paired measurements were obtained using ArteVu on the right index finger and the Omron device on the left upper arm. As expected, SBP, DBP, and HR increased after exercise; however, the magnitude of elevation varied considerably between individuals. ArteVu successfully obtained continuous pulse waveforms during the 5-minute recording period for all participants. Visual inspection suggested greater variability between the two devices immediately after exercise compared with rest, which is likely attributable to movement artifacts, transient changes in finger perfusion, or slight alterations in fingertip position.

Agreement between ArteVu and Omron was evaluated using Bland–Altman analysis. The mean differences (±SD) between ArteVu and Omron were 3.6 ± 12.9 mmHg for SBP, −2.7 ± 8.1 mmHg for DBP, and 0.3 ± 0.94 bpm for HR. For all parameters, the mean error remained within clinically acceptable limits according to ISO 81060-2 criteria, although the limits of agreement were moderately wide. Bootstrap resampling of 30 datasets produced similar mean differences and limits of agreement, supporting the robustness of the findings despite the small sample size.





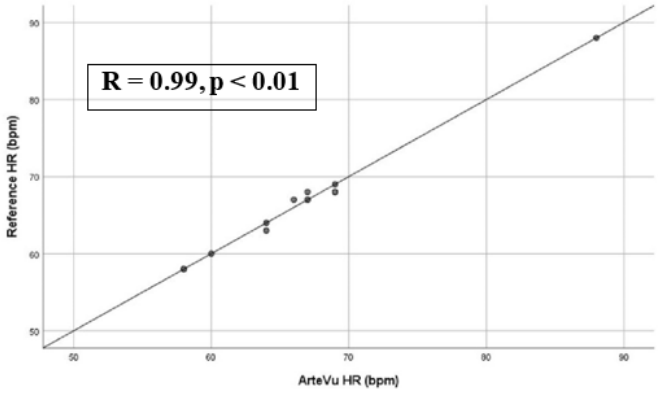


Figure 2 (a): Scatter plot. Measurements taken immediately after exercise load.

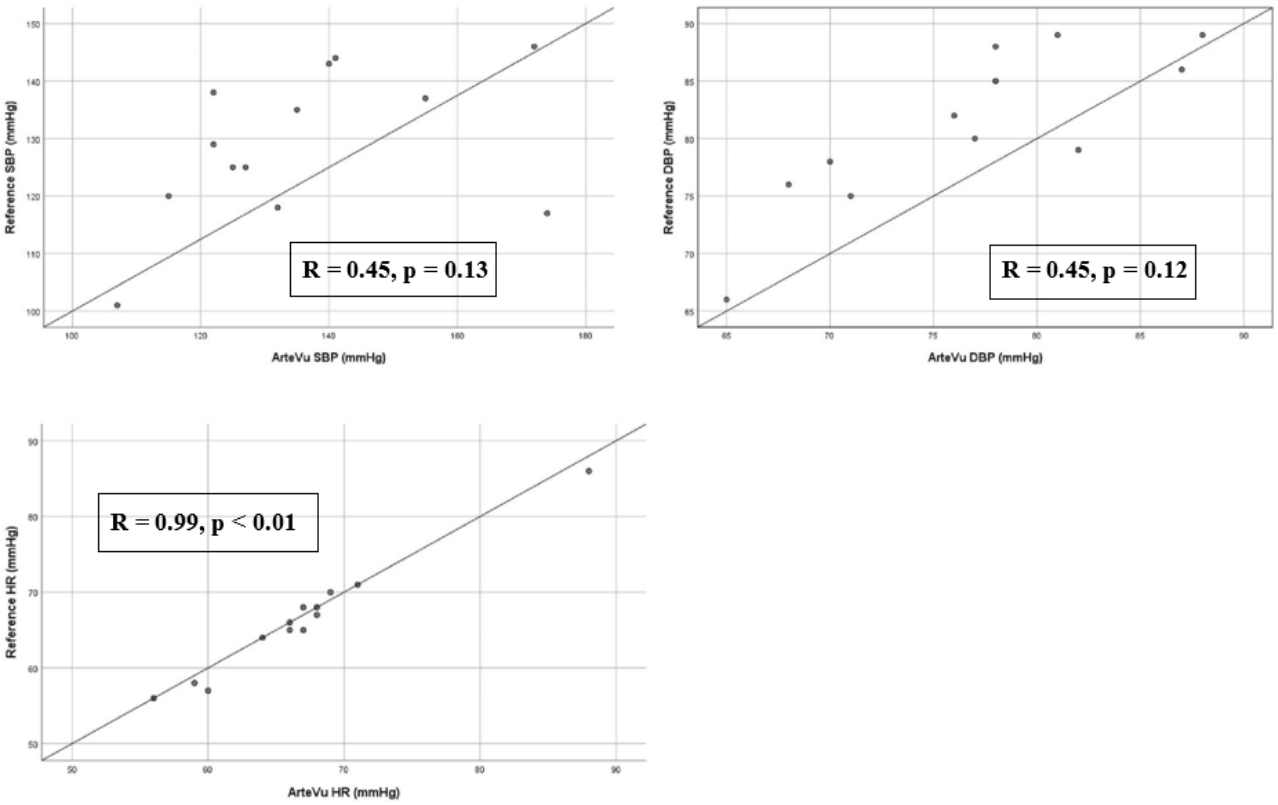


Figure 2(b): Scatter plots. Measurement value after 5 minutes of loading.

Continuous waveform recordings obtained by ArteVu allowed qualitative evaluation of pulse morphology. Representative waveforms are shown in Figure 3; the control waveform displayed clear systolic peaks and dicrotic notches, whereas the waveform from one participant exhibited markedly abnormal morphology. This participant's questionnaire responses indicated a history of elevated BP, and the waveform pattern was consistent with previously described changes in arterial stiffness [8].

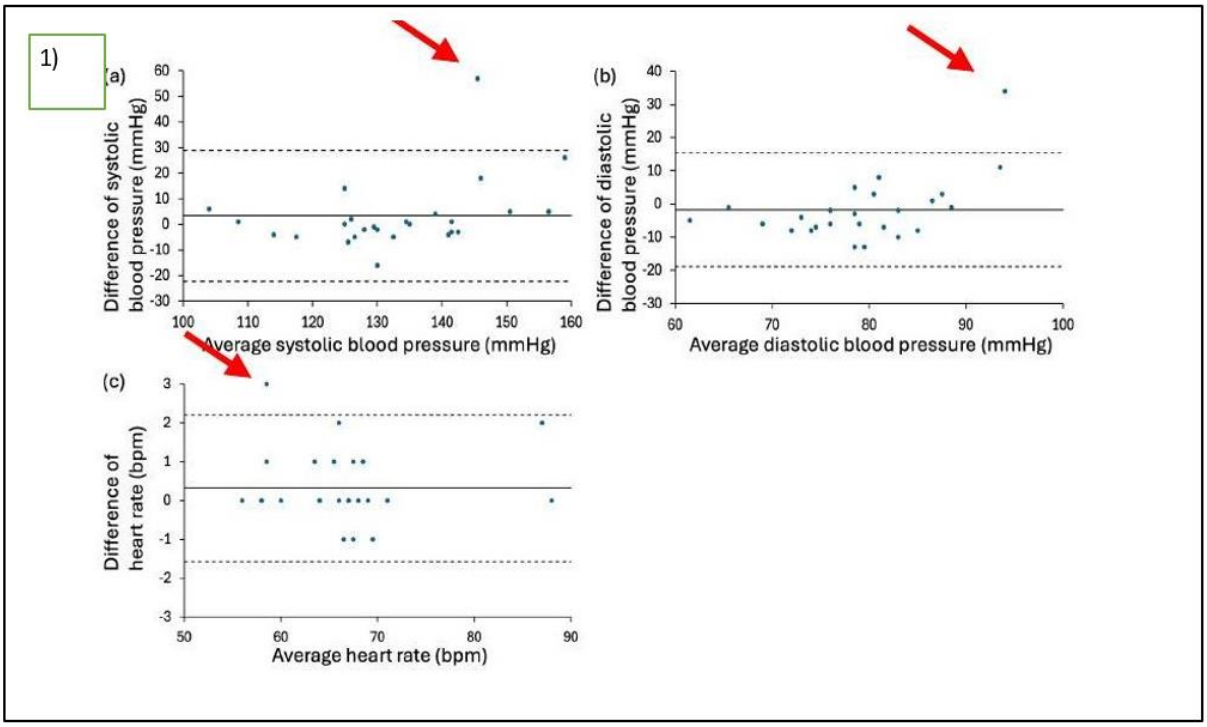


Figure 3(1): Bland–Altman Plot for Precision Analysis.

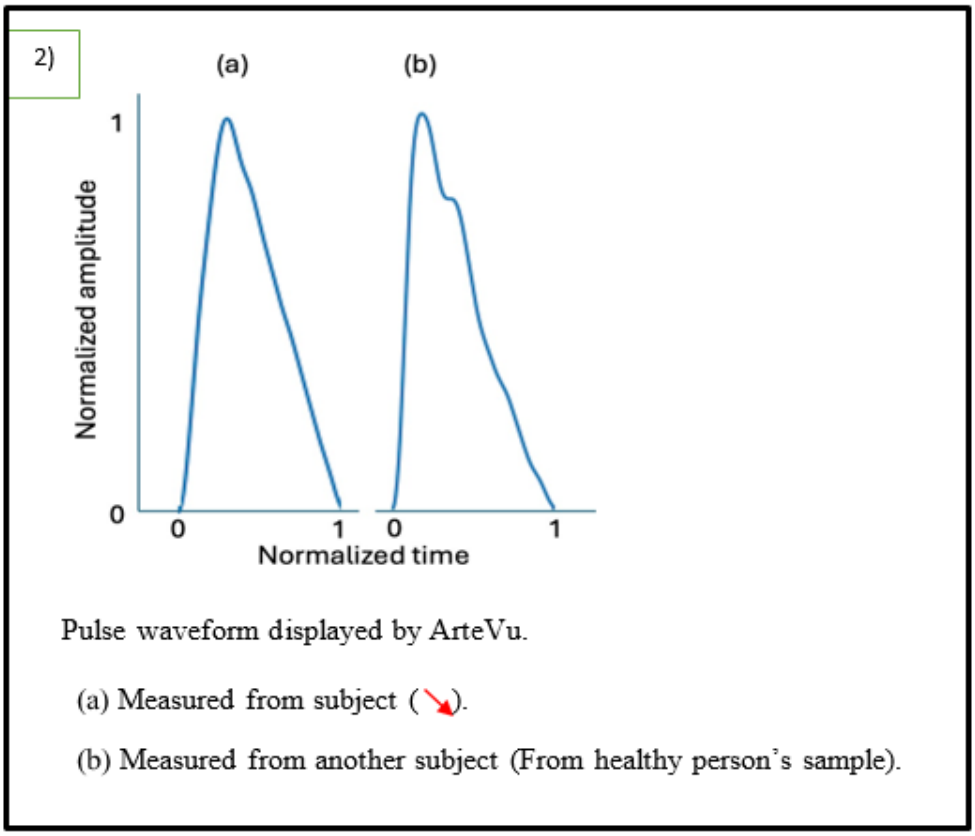


Figure 3(2): Pulse waveform. Right side wave is healthy person (control wave) and left side wave is one of the test subjects.

Questionnaire results are summarized in Table 2. Overall, participants reported high levels of comfort while wearing ArteVu, with mean visual analogue scale (VAS) scores exceeding 80 for pain, pressure, and overall discomfort. The ease of locating and maintaining the fingertip position was also rated favorably, although some women with thin fingers required gauze padding under the band to achieve a secure fit. Participants with known hypertension tended to rate the device as particularly easy to use and expressed strong interest in using a compact fingertip-only version in the future. Notably, even participants who did not own a home BP monitor showed high acceptance of ArteVu, suggesting that such a device may encourage BP self-monitoring among individuals who are not currently engaged in regular home measurements.

Taken together, these results indicate that ArteVu provides BP measurements that generally agree with those of a validated home BP monitor, can capture continuous waveforms useful for pulse morphology assessment, and is well accepted by older adults in a community setting.

a. Questionnaire items

(1) Did you feel any pain while wearing it?

(2) Did you feel any pressure while wearing it?

(3) Did you feel any dampness while wearing it?

(4) Did you feel any discomfort while wearing it?

(5) Was the position of the cuff easy to find?

(6) In the last 5 years, have you been told you have high or low blood pressure at a health checkup or at your family doctor's?

(7) Do you have a blood pressure monitor at home?

(8) If you have a blood pressure monitor, how often do you use it?

(9) If a compact, functional blood pressure monitor with good usability were to be released in the future, would you consider purchasing and using it?

b. Questionnaire results (Mean VAS by each classification group)

	No pain	No pressure	Comfortable	Position clear
Sex				
Man	99.09	97.25	91.86	85.84
Woman	89.79	*52.65	94.39	74.70
Dr's point				
None	94.02	87.47	83.98	63.75
Hypertension	94.23	91.31	91.76	94.72
Planed purchase				
None	93.87	88.38	85.53	73.84
Consideration	94.47	90.30	90.47	85.61

* Some of the women had thin fingers and had to have gauze wrapped around them for the bandage to fit.

Table 2: Questionnaire items (a) and answers (b).

Discussion

This study evaluated the accuracy and feasibility of the ArteVu fingertip BP monitor by comparing its measurements with those of a validated home BP device in healthy older adults. Overall, ArteVu demonstrated acceptable agreement with the reference monitor, supporting its potential as a continuous, noninvasive BP monitoring tool suitable for use outside clinical settings.

Continuous BP monitoring has long been recognized as important for detecting masked hypertension, morning BP surges, nocturnal hypertension, and day-to-night variability, all of which are associated with an increased risk of cardiovascular events [3–7]. Although ABPM can provide such information, its use in Japan is largely limited to patients who already attend clinics and is contingent on physician judgment. Individuals who do not routinely seek medical care may therefore remain undiagnosed, even if they have clinically relevant BP abnormalities. A user-friendly fingertip device such as ArteVu could help bridge this gap by enabling continuous or repeated BP estimation in daily life.

In the present study, ArteVu and the Omron device showed small mean differences for SBP, DBP, and HR, with acceptable limits of agreement under ISO 81060-2 criteria. However, variability between devices was greater immediately after exercise than at rest. Several technical factors may explain this finding. Despite instructing participants to keep their hands still, maintaining a completely stable finger position for 5 minutes after exercise is challenging, and sweat or minor shifts in contact between the finger and sensor may have affected signal quality. These factors highlight areas where future refinement—such as improved attachment mechanisms or enhanced motion-artifact compensation algorithms—could further stabilize measurements.

Continuous waveform analysis provided additional insights beyond single BP values. In one participant, ArteVu identified an abnormal pulse waveform that corresponded to a history of elevated BP reported in the questionnaire. Previous studies of invasive and noninvasive arterial waveform monitoring have demonstrated that changes in pulse contour can reflect arterial stiffness and vascular pathology [8]. The ability of ArteVu to record and store pulse waveforms suggests potential applications in the early detection of vascular abnormalities, although this requires further investigation in larger cohorts.

The questionnaire results showed high levels of comfort and acceptability, even among participants aged over 60 years. This is particularly important because long-term adherence to BP monitoring depends not only on accuracy but also on convenience and tolerability. Prior work has indicated that only around 20–25% of individuals receiving antihypertensive treatment regularly measure their BP at home [9]. Devices that are painless, easy to wear, and capable of continuous or frequent measurement may help increase the proportion of patients who engage in active BP self-management.

In Japan, recent revisions to the medical fee schedule have strengthened the emphasis on lifestyle-related disease management, including hypertension [10]. As healthcare policy increasingly prioritizes preventive care, tools that support self-monitoring and early detection of abnormal BP patterns will become more important. ArteVu, especially in future miniaturized fingertip-only versions, may fit well within this preventive framework by providing simple, noninvasive, and informative BP monitoring in daily life.

Limitations

This study has several limitations. First, the sample size was small, and participants were recruited from a university-based health class, introducing selection bias toward health-conscious older adults. Second, BP was measured on different limbs (right finger for ArteVu and left upper arm for Omron), and physiological side-to-side differences may have contributed to measurement discrepancies. Third, the exercise load was not standardized quantitatively, which could have influenced post-exercise BP responses and signal stability. Fourth, although Bland–Altman analysis and bootstrap resampling were used to strengthen the evaluation, the study assessed only short-term performance under limited conditions. Seasonal variation, long-term device drift, and performance after software or hardware updates were not evaluated.

Future perspectives

Further studies with larger and more diverse populations are needed to validate ArteVu across a range of clinical and real-world conditions. Standardized exercise protocols, comparison with ABPM, and integration with smartphone applications may help clarify the device's role in routine practice. If future models maintain or improve accuracy while enhancing usability, ArteVu could become a valuable tool for preventive cardiovascular care and home-based BP management.

Conclusion

The ArteVu fingertip BP monitor showed acceptable agreement with a validated home BP device, provided continuous waveform data that may aid in the assessment of vascular status, and was well accepted by older adults in a community setting. Although measurement variability increased after exercise and several methodological limitations remain, the findings support the feasibility of ArteVu as a noninvasive, continuous BP monitoring tool.

With further refinement, long-term validation, and integration into preventive care strategies, ArteVu may contribute to improved BP self-monitoring and early detection of cardiovascular risk.

Sources of Funding

Natsuko Mizutani's personal research expenses.

Ethics

The project number is 2024-28 in Kyorin University Faculty of Health Sciences Ethics Review Committee.

Disclosures

The blood pressure monitor used for the measurements, ArteVu, was borrowed from Taiwan's CARDIORING. For large-scale measurement events, employees from Taiwan's CARDIORING were dispatched.

Conflict of interest

The authors have no conflicts of interests to declare.

References

1. Martinez MA, Garcia-Puig J, Martin JC, Guallar-Castillon P, Aguirre de Carcer A, Torre A, Armada E, Nevado A, Madero RS. (1999).Frequency and determinants of white-coat hypertension in mild to moderate hypertension: a primary care–based study. Am J Hypertens; 12:251-259.
2. Kario K, Pickering TG, Umeda Y, Hoshide S, Hoshide Y, Morinari M, et al. (2003).Morning surge in blood pressure as a predictor of silent and clinical cerebrovascular disease in elderly hypertensives. Circulation; 107:1401-1406.
3. Kario K. (2010). Morning surge in blood pressure and cardiovascular risk: evidence and perspectives. Hypertension.; 56:765-773.
4. Fujiwara T, Yano Y, Hoshide S, Kanegae H, Kario K. (2018).Association of cardiovascular outcomes with masked hypertension defined by home blood pressure monitoring in a Japanese general practice population. JAMA Cardiol.; 3:583-590.
5. Kuwabara M, Harada K, Hishiki Y, Ohkubo T, Kario K, Imai Y. (2020).Validation of a wrist-type home nocturnal blood pressure monitor in sitting and supine positions according to ANSI/AAMI/ISO 81060-2:2013 guidelines. J Clin Hypertens.; 22:970-978.
6. Narita K, Hoshide S, Kario K. (2023).Short- to long-term blood pressure variability: current evidence and new evaluations. Hypertens Res.; 46:950-958.
7. Kario K. (2018).Essential Manual on Perfect 24-hour Blood Pressure Management: From Morning to Nocturnal Hypertension. Wiley-Blackwell
8. Saugel B, Kouz K, Meidert AS, Schulte-Uentrop L, Romagnoli S. (2020).How to measure blood pressure using an arterial catheter. Crit Care.; 24:172.
9. Tatsumi Y, Shima A, Kawamura A, Morino A, Kawatsu Y, Ohkubo T. (2021).Current status of home blood pressure measurement and relevant demographics and lifestyle characteristics among periodic users: a cross-sectional worksite study. Sangyo Eisei.; 63:43-52.
10. Ministry of Health, Labour and Welfare. Outline of FY 2024 Revision of Medical Fee in Japan. Tokyo: MHLW; 2024.

DOI:10.31579/2692-9759/177