Comparison of competitive Face-Scanning Technologies in terms of Blood Pressure and Heart Rate.

The main goal of the study was to assess the accuracy of physiological measurements, such as Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP) and Heart Rate (HR) obtained with Mobile Apps with integrated technologies: Binah.AI, Nuralogix and Shen.AI in comparison with automatic, certified Omron M4 Intelli IT blood pressure monitor. The additional purpose was to determine the factors limiting the measurements in difficult environmental conditions such as low light as well as inclusivity of individuals with darker skin tones (phototypes >4 according to Fitzpatrick scale).

ACCURACY ASSESSMENT, DATA COLLECTION AND RESULTS

Study was carried out on 100 volunteers aged 19 to 78 years (mean 47), of whom 62 were females. Each participant was measured with three different apps simultaneously. All three apps were installed on the same model of smartphone (OnePlus 8 Pro, Android 12, Qualcomm Snapdragon 865 Octa-core). The subjects remained seated throughout the study. Smartphones were mounted on a tripod at a distance of about 30 cm from the face. Measurements of physiological indicators, obtained through tested apps were started simultaneously, in parallel, Omron M4 Intelli IT measurements were performed. The range of measured heart rate in the subjects was 52 - 102 (mean 74), for systolic blood pressure was 91 - 177 (mean 126), and for diastolic blood pressure was 61 - 113 (mean 80). Every participant was measured once.

Heart Rate measurement of the examined products proved to be accurate. It seems that Shen.AI and Binah.AI have similar accuracy (SD: 2.7 vs. 2.8), while Nuralogix shows slightly lower accuracy (SD: 3.1). The accuracy of the Binah.AI technology measured by the standard deviation is 14.1 for SBP and 8.5 for DBP. Study demonstrated slightly higher accuracy for Nuralogix (SBP 12.1; DBP 7.2). The Shen.AI technology yielded the most precise measurements of both systolic and diastolic blood pressure in comparison to Binah.AI and Nuralogix. Among those tested Shen.AI is the only technology for which the standard deviation for both SBP and DBP does not exceed 10 (SBP: 9.9; DBP: 6.9).

Table 1. Accuracy and precision of Heart Rate, Systolic Blood Pressure and Diastolic Blood Pressure measurements performed with Binah.AI, Nuralogix and Shen.AI as compared with reference measurements. ME- mean error, SD- standard deviation, MAE- mean absolute error, RMSE- root-mean-square error.

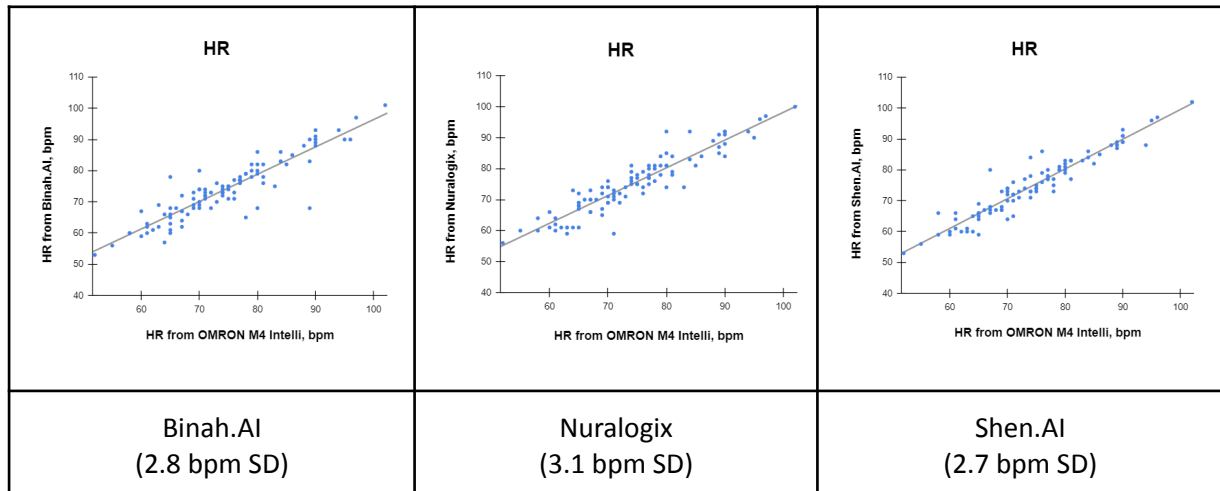| *Main parameters*		ME	SD	MAE	RMSE
Heart Rate					
	Binah.AI	-0.2	**2.8**	2.1	2.8
	Nuralogix	0.8	**3.1**	2.7	3.2
	Shen.AI	0.2	**2.7**	1.9	2.7
Systolic BP					
	Binah.AI	-1.6	**14.1**	11.8	14.1
	Nuralogix	-4.4	**12.1**	10.8	12.8
	Shen.AI	0.9	**9.9**	8.0	9.9
Diastolic BP					
	Binah.AI	-3.0	**8.5**	7.4	9.0
	Nuralogix	3.5	**7.2**	6.6	8.0
	Shen.AI	1.4	**6.9**	5.6	7.0

HEART RATE

Fig 1. Heart rate estimated using the Binah.AI, Nuralogix and Shen.AI technology plotted against the reference values obtained simultaneously with the Omron M4 Blood pressure monitor.
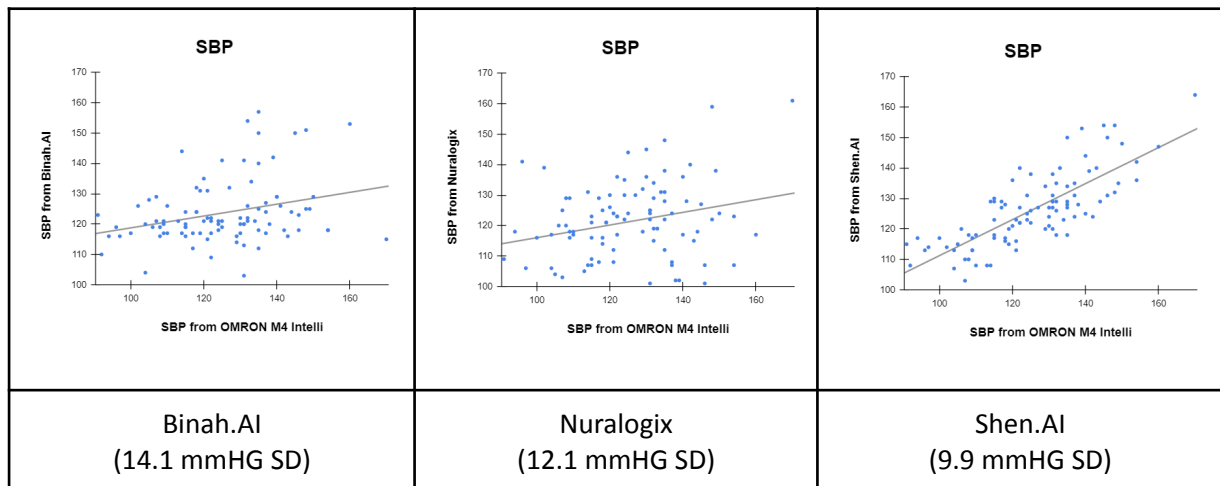
SYSTOLIC BLOOD PRESSURE

Fig 2. Systolic blood pressure estimated using the Binah.AI, Nuralogix and Shen.AI technology plotted against the reference values obtained simultaneously with the Omron M4 Blood pressure monitor.

DIASTOLIC BLOOD PRESSURE

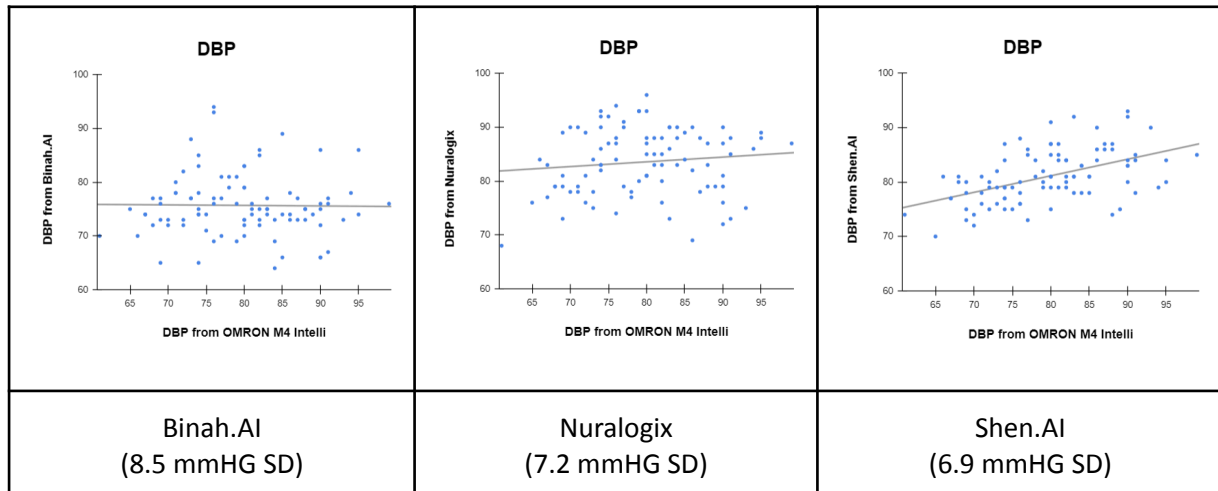|		
Binah.AI (8.5 mmHG SD)	Nuralogix (7.2 mmHG SD)	Shen.AI (6.9 mmHG SD)

Fig 3. Diastolic blood pressure estimated using the Binah.AI, Nuralogix and Shen.AI technology plotted against the reference values obtained simultaneously with the Omron M4 Blood pressure monitor.

RELIABILITY IN LOW-LIGHT CONDITIONS AND INCLUSIVITY FOR VARIOUS SKIN TONES

To achieve the additional aim of the study the measurement sessions under various conditions, including varying light intensity and facial light reflexes. During measurement, session factors were altered manually and light intensity was measured using an electronic lux meter prior to every test.

Tests involving individuals with high phototype (Fitzpatrick scale = 5) were conducted under 810 lux of natural light, and all tested applications were functioning properly under these conditions. However, when the light intensity was reduced (500 lux, natural light) or when artificial light was used at 700 lux, issues arose with Binah.AI. It displayed a light indicator command on the screen, rendering the measurement unable to complete. Similar occurrences were observed when utilizing Nuralogix under 2500 lux of natural light and facial light reflexes. The Shen.AI technology performed effectively under the aforementioned conditions.

CONCLUSIONS

In a study comparing mobile app technologies for vital sign monitoring conducted in at-home scenarios**, Shen.AI stands out as the best among the three competitors, including Binah.AI and Nuralogix. Shen.AI leads in accuracy for heart rate, systolic, and diastolic blood pressure measurements**, as evidenced by its lowest standard deviations, proving its superiority in precision. Its consistent accuracy across various lighting conditions and for individuals with darker skin tones makes **Shen.A the most versatile and inclusive option among Face-Scanning Technologies.**

While Binah.AI and Nuralogix face challenges under specific environmental conditions and with inclusivity, Shen.AI consistently outperforms them, demonstrating its superiority as the most reliable choice for a broad range of users. This adaptability ensures Shen.AI is recognized as the best technology for dependable and inclusive health monitoring in at-home settings. Shen.AI's superior performance in accuracy, environmental adaptability, and inclusivity establishes it as the leading choice among the evaluated technologies, providing the most effective solution for monitoring vital signs at home.

	Binah.AI	**Nuralogix**	**Shen.AI**
Heart Rate [bpm SD]	2.8	3.1	**2.7**
Systolic Blood Pressure [mmHG SD]	14.1	12.1	**9.9**
Diastolic Blood Pressure [mmHG SD]	8.5	7.2	**6.9**

Table 2. Accuracy and precision of Heart Rate, Systolic Blood Pressure and Diastolic Blood Pressure measurements performed with Binah.AI, Nuralogix and Shen.AI as compared with reference measurements, SD- standard deviation.