

Automated Oscillometric and Hybrid Manual Auscultatory Device for Blood Pressure Measurement among Children in the Korea National Health Survey

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Main finding

Following the mercury ban under the Minamata Convention, South Korea has initiated *efforts to replace mercury-based blood pressure devices* in national health surveys. This study, part of a series of investigations, compared automated oscillometric device (OD, microlife) to hybrid manual auscultatory device (AD, Greenlight) as the gold standard *in children aged 6 to 18 years*. However, the findings **do not provide conclusive evidence supporting the replacement of AD with OD.**

BACKGROUND

- Following the ban on mercury under the Minamata Convention, South Korea has begun efforts to replace mercury-based blood pressure (BP) devices in national health surveys.
- The Korea National Health and Nutrition Examination Survey had adopted hybrid manual auscultatory device (AD) for adults, but auscultation required significant survey quality control efforts due to high interrater variability. Therefore, studies have been conducted to replace it with automated oscillometric device (OD).
- However, there are questions about the feasibility of automated sphygmomanometers for measuring blood pressure in children aged 6-18 years.
- Previous studies have examined the validity of AD in children, so this study sought to determine if OD could replace AD.

RESULTS

Table 1. Age, sex distributions of study participants

	Overall		Boys		Girls	
	N	(%)	N	(%)	N	(%)
Age (year)	251	(100.0)	121	(48.2)	130	(51.8)
6-12	113	(45.0)	56	(46.3)	57	(43.8)
13-15	85	(33.9)	42	(34.7)	43	(33.1)
16-18	53	(21.1)	23	(19.0)	30	(23.1)

N: Number

Table 2. BP distributions according to age and sex

	Boys				Girls				
	Mean	Min	Max	Std	Mean	Min	Max	Std	
AD SBP	107.79	85	137	9.13	103.05	85	123	7.73	
OD SBP	108.99	85.5	132	9.41	102.28	81	124.5	7.9	
OD - AD SBP	1.21	-17	25	6.34	-0.77	-14.5	11	5.25	
AD DBP	63.88	49	84	8.24	63.57	47	86	7.21	
OD DBP	63.34	50.5	86.5	6.61	61.4	46	79.5	5.44	
OD - AD DBP	-0.54	-16.5	31.5	6.9	-2.17	-18	14.5	5.78	
		6-12 years old				13-18 years old			
		Mean	Std	Min	Max	Mean	Std	Min	Max
AD SBP	104.18	8.51	85	124	106.32	8.84	85	137	
OD SBP	104.06	9.22	81	124.5	106.71	9.18	86	132	
OD - AD SBP	-0.12	5.66	-13	13.5	0.39	6.05	-17	25	
AD DBP	62.12	6.69	47	84	65.03	8.25	47	86	
OD DBP	61.67	5.87	46	79.5	62.71	5.91	50.5	84	
OD - AD DBP	-0.45	5.61	-16	14.5	-2.32	6.32	-18	13	

Std: Standard deviation, Min: minimum, Max: Maximum

CONCLUSION

- The results are insufficient to provide conclusive evidence that OD could replace AD.
- Given the critical importance of childhood blood pressure for long-term health outcomes, continued measurement of blood pressure in children in national health surveys is essential.
- Further research is needed to identify valid and reliable devices for accurately measuring blood pressure in pediatric populations.

METHODS

- In 2022, a survey of 251 children with equal gender and age distribution (6-12 and 13-18 years) was conducted following KNHANES protocol and BP measurement guidelines, with informed consent from children and parents.
- The Microlife WatchBP Office AFIB® (OD) and Greenlight 300TM® (AD) were compared according to 2018 Universal Standard guidelines.
- To prevent memory bias, AD measurements preceded OD. BP discrepancies were calculated by subtracting AD from OD values.
- Mean device differences by gender, age, and measurer were analyzed using Pearson's correlation, Lin's concordance correlation coefficients (CCC), and Bland-Altman plots with limit of agreement (LOA).



Table 3. CC and CCC between OD and AD

		OD - AD		CC (95%CI)	CCC(95%CI)
		Mean (SD)			
Overall	SBP	0.16 (5.87)	0.79 (0.74, 0.83)	0.79 (0.74, 0.83)	0.79 (0.74, 0.83)
	DBP	-1.48 (6.07)	0.63 (0.55, 0.70)	0.63 (0.55, 0.70)	0.60 (0.52, 0.67)
Sex	Boy	SBP 1.16 (6.34)	0.77 (0.68, 0.83)	0.76 (0.67, 0.83)	0.76 (0.67, 0.83)
	DBP	-0.74 (6.30)	0.65 (0.54, 0.75)	0.63 (0.51, 0.72)	0.63 (0.51, 0.72)
	Girl	SBP -0.77 (5.25)	0.77 (0.69, 0.84)	0.77 (0.69, 0.83)	0.77 (0.69, 0.83)
	DBP	-2.17 (5.78)	0.61 (0.49, 0.71)	0.56 (0.44, 0.66)	0.56 (0.44, 0.66)
Age group	6-12 years old	SBP -0.12 (5.66)	0.80 (0.72, 0.86)	0.80 (0.72, 0.86)	0.80 (0.72, 0.86)
	DBP	-0.45 (5.61)	0.61 (0.47, 0.71)	0.60 (0.47, 0.71)	0.60 (0.47, 0.71)
	13-18 years old	SBP 0.39 (6.05)	0.78 (0.70, 0.83)	0.77 (0.70, 0.83)	0.77 (0.70, 0.83)
	DBP	-2.32 (6.32)	0.65 (0.54, 0.74)	0.58 (0.48, 0.67)	0.58 (0.48, 0.67)

CC: Pearson's correlation, CCC: Lin's concordance correlation coefficients

Table 4. Limits of agreement between OD and AD

	Bland-Altman LOA	
	SBP	DBP
Overall	0.16 (-11.34, 11.66)	-1.48 (-13.37, 10.42)
Boys	1.16 (-11.26, 13.58)	-0.74 (-13.08, 11.61)
Girls	-0.77 (-11.05, 9.52)	-2.17 (-13.50, 9.17)
6-12 years old	-0.12 (-11.21, 10.97)	-0.45 (-11.45, 10.54)
13-18 years old	0.39 (-11.46, 12.24)	-2.32 (-14.70, 10.06)
6-12 years old, Boys	-0.22 (-11.41, 10.96)	-0.93 (-12.11, 10.25)
6-12 years old, Girls	-0.02 (-11.10, 11.07)	0.02 (-10.82, 10.85)
13-18 years old, Boys	2.35 (-10.69, 15.38)	-0.57 (-13.92, 12.78)
13-18 years old, Girls	-1.35 (-10.89, 8.19)	-3.88 (-14.51, 6.75)

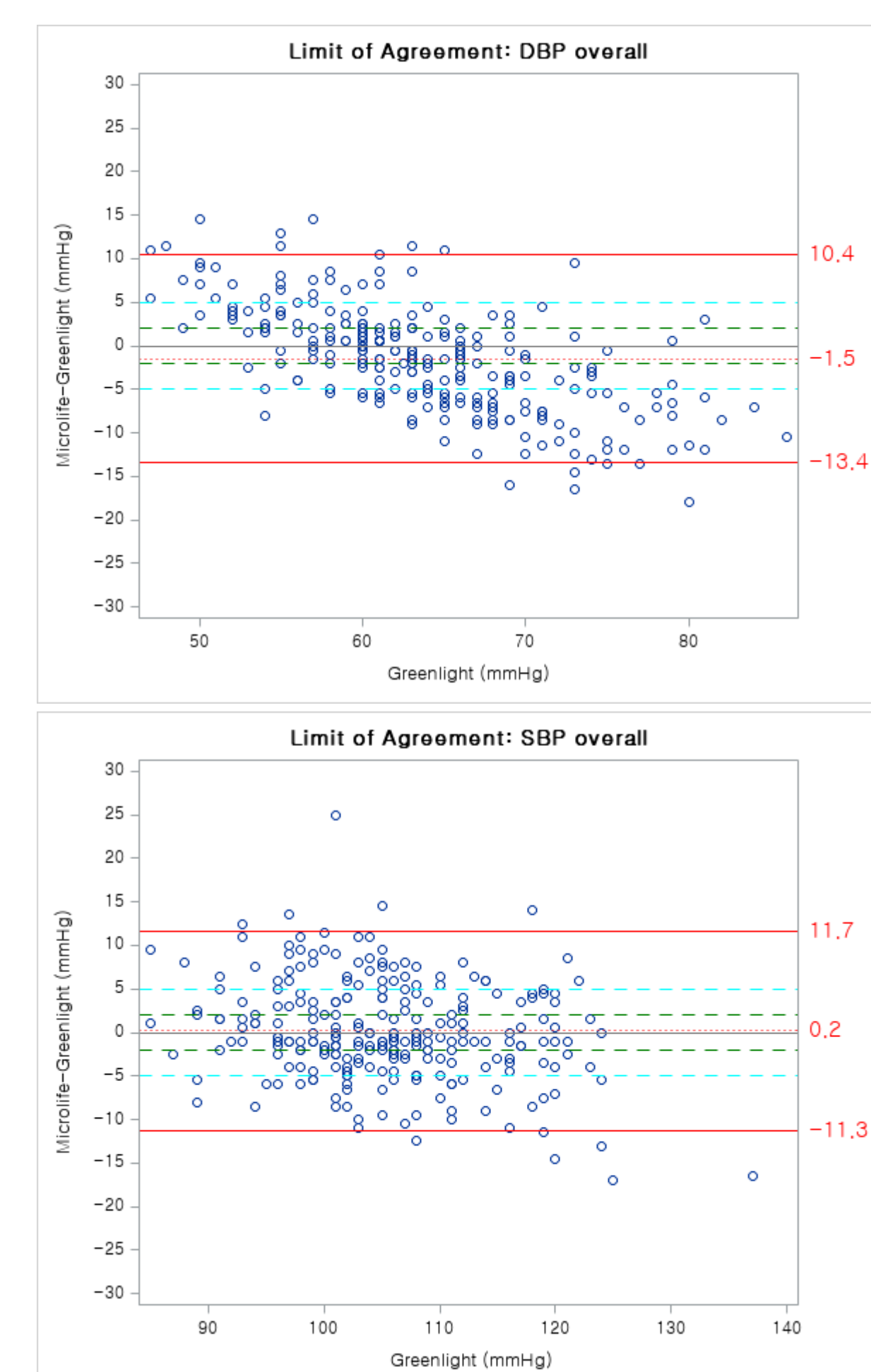


Figure 1. Bland-Altman plot for overall population

Additional key information

Other Key Information

- Standardized BP protocol of KNHANES:** Kim H-L, Park SM, Cho J, et al. Standardized protocol of blood pressure measurement and quality control program for the Korea National Health and Nutrition Examination Survey. *Clinical hypertension*. 2023-10-12 2023;29(1):doi:10.1186/s40885-023-00252-7
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- Non-mercury devices for children:** Kim SH, Kim Y-M, Kim SH, Shin J, Lee EM. Replacing mercury sphygmomanometers with mercury-free sphygmomanometers for the National Health Survey in children: direct comparisons applying two types of mercury-free sphygmomanometer. *Korean Circulation Journal*. 2024-05-01 2024;54(5):270.

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