Physical activity in the South Korea measured by accelerometer

Jungjun Lim [1], Hoyong Sung [1], Joonsik Kim [1], Harim Choi [1], On Lee [2], Seung-Soo Baek [3], Hyoyoul Moon [1,4], Yeonsoo Kim [1,4*]
[1] Department of Physical Education, Seoul National University
[2] Korea Institute Sports Science
[3] Department of Sport & Health Care, College of Art & Culture, Sangmyung University, Seoul, Korea
[4] Institute Sports Science, Seoul National University

INTROTUCTION

In 2004, objective assessment of physical activity(PA) with accelerometers was implemented in the Korea National Health and Nutrition Examination Survey(KNHANES). The accelerometer data from NHANES 2014~2015 provide the first objective measures of PA for the Korean population. The purpose of this study was to evaluate the PA levels, using objective data obtained with accelerometers.

METHODS

For the PA monitor component, all ambulatory examined participants age 19-65 years were asked to wear an Actigraph (Florida, USA) model wGT4X+ accelerometer over the right hip on an elasticized belt for the 7 days after their examination. Participants were asked to wear the device while they were awake and to take it off for swimming or bathing. The Korea Centers for Disease Control and Prevention ethics review board approved the survey protocols, and informed consent was obtained for all subjects.
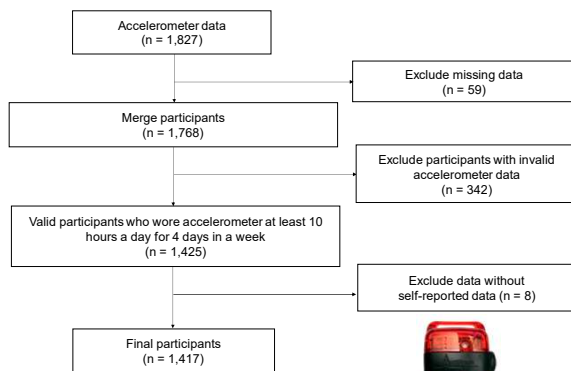
Accelerometer data (n = 1,827)
Exclude missing data (n = 59)
Merge participants (n = 1,768)
Exclude participants with invalid accelerometer data (n = 342)
Valid participants who wore accelerometer at least 10 hours a day for 4 days in a week (n = 1,425)
Exclude data without self-reported data (n = 8)
Final participants (n = 1,417)

Figure 1. Flow diagram of participants excluded

Figure 2. Actigraph wGT3X +

For the analyses presented here, a valid day was defined as having 10 or more hours of monitor wear. Wear time was determined by subtracting non-wear time from 24 hours. Non-wear was defined by an interval of at least 60 consecutive minutes of zero activity intensity counts, with allowance for 1–2 min of counts between 0 and 100. The accelerometers were programmed to record data in 1-minute intervals (epochs). Light, moderate, and vigorous PA were estimated from accelerometer counts per minutes(CPM) using cut points established from a weighted average of four previously published thresholds.

RESULTS

Table 1. Characteristics (mean and SE) of the sample

	19-29		30-39		40-49		50-59		60-65	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
N	81	129	103	175	126	239	140	260	64	99
Age (years)	23.4 (0.3)	24.2 (0.2)	35.0 (0.2)	35.3 (0.2)	44.6 (0.2)	44.8 (0.1)	54.9 (0.2)	54.6 (0.1)	61.9 (0.1)	61.9 (0.1)
Height (cm)	174.0 (0.5)	161.4 (0.5)	173.8 (0.5)	161.1 (0.4)	171.5 (0.4)	158.6 (0.3)	168.7 (0.5)	156.2 (0.2)	168.2 (0.7)	154.6 (0.5)
Weight (kg)	71.8 (1.3)	56.1 (0.7)	76.3 (1.0)	59.1 (0.7)	71.7 (0.9)	57.6 (0.5)	70.7 (0.7)	58.6 (0.5)	69.4 (1.1)	58.0 (0.7)
BMI (kg/m2)	23.6 (0.4)	21.5 (0.2)	25.2 (0.3)	22.7 (0.2)	24.3 (0.2)	22.8 (0.1)	24.8 (0.2)	24.0 (0.2)	24.5 (0.3)	24.2 (0.2)
Obese (%)	25.9 (0.4)	11.6 (0.2)	54.8 (0.4)	21.2 (0.3)	34.9 (0.4)	20.7 (0.2)	44.2 (0.4)	33.5 (0.2)	43.7 (0.6)	36.3 (0.4)

Table 2. Sample response rates for number of days wearing accelerometer, by age and gender

Age	Gender	Number of valid days of accelerometer wear (%)							
		0	1	2	3	4	5	6	7
19-29	Male	12.5	9.7	9.7	11.8	13.9	20.8	11.1	10.4
	Female	9.2	7.3	11.7	9.2	14.6	16.5	16.5	15.0
30-39	Male	2.9	5.7	8.6	8.6	11.4	22.9	19.3	20.7
	Female	3.1	4.0	5.8	9.7	10.6	11.5	22.6	32.7
40-49	Male	0.7	-	4.3	4.3	7.9	19.4	17.3	46.0
	Female	1.1	2.6	3.0	3.0	4.5	16.1	24.7	44.9
50-59	Male	1.8	3.1	5.5	3.7	8.0	12.3	23.9	41.7
	Female	2.0	3.3	2.7	3.0	8.0	12.4	21.7	46.8
60-65	Male	1.3	3.9	3.9	6.6	9.2	5.3	22.4	47.4
	Female	0.9	1.9	1.9	2.8	0.9	17.8	23.4	50.5

> Accelerometer outcomes:
> ✓ Accelerometer-Total(AT): every minute that meets the specific criterion
> ✓ Accelerometer-Bout(AB): 10 or more consecutive minutes above the relevant threshold, with allowance for interruptions of 1 or 2 minute below threshold
> ✓ Accelerometer moderate to vigorous PA: 1 minute of vigorous intensity physical activity counts as 2 minutes of moderate intensity physical activity → [moderate PA + vigorous PA ×2]
> ✓ Adherence to PA recommendations: 600MET-minutes/week
> → [(moderate PA × 4METs) + (vigorous PA × 8METs)] ≥ 600METs
> ❖ Accelerometer CPM: 100 ≤ Light PA < 2020; 2,020≤ Moderate PA <5998; Vigorous PA >5998

Table 3. Minutes per day (mean and SE) of light, moderate, vigorous and MVPA according to self-report and accelerometer

	Males				Females			
	Light	Moderate	Vigorous	MVPA	Light	Moderate	Vigorous	MVPA
SR, Age (yrs)								
19-29	-	101.9 (16.4)	27.9 (7.6)	129.9 (17.7)	-	71.0 (6.8)	6.1 (1.9)	77.1 (7.2)
30-39	-	70.4 (9.1)	25.5 (5.6)	96.0 (11.8)	-	75.2 (8.0)	4.9 (1.1)	80.1 (8.0)
40-49	-	57.9 (6.2)	19.4 (3.7)	77.4 (8.1)	-	53.8 (4.3)	7.4 (1.4)	61.3 (4.8)
50-59	-	60.5 (6.3)	23.0 (4.0)	83.5 (8.1)	-	47.6 (3.7)	7.5 (2.0)	55.2 (4.8)
60-65	-	72.5 (12.8)	44.1 (13.0)	116.7 (19.4)	-	52.6 (8.9)	3.0 (1.1)	55.6 (9.0)
19-65	-	69.7 (4.2)	26.0 (2.7)	95.8 (5.3)	-	58.0 (2.6)	6.2 (0.7)	64.3 (2.8)
AT, Age (yrs)								
19-29	250.6 (11.7)	41.9 (2.8)	1.7 (0.3)	45.4 (3.1)	254.9 (7.1)	30.0 (1.5)	0.5 (0.1)	31.0 (1.5)
30-39	301.7 (9.4)	38.0 (2.6)	0.4 (0.1)	38.8 (2.7)	305.0 (5.7)	24.6 (1.6)	0.2 (0.1)	25.1 (1.7)
40-49	306.3 (8.6)	35.0 (1.8)	0.7 (0.2)	36.5 (2.0)	313.4 (5.5)	29.8 (1.4)	0.6 (0.2)	31.1 (1.5)
50-59	321.1 (8.1)	37.3 (2.2)	0.9 (0.2)	39.2 (2.4)	333.4 (6.2)	32.8 (1.4)	0.2 (0.0)	33.3 (1.5)
60-65	303.7 (13.7)	45.8 (4.1)	1.2 (0.9)	48.3 (4.5)	345.1 (8.4)	35.6 (2.4)	0.3 (1.1)	36.3 (2.5)
19-65	300.6 (4.48)	38.7 (1.1)	0.9 (0.1)	40.6 (1.2)	313.0 (3.0)	30.3 (0.7)	0.4 (0.0)	31.1 (0.7)
AB, Age (yrs)								
19-29	-	16.3 (1.9)	0.6 (0.3)	17.7 (1.9)	-	12.4 (1.1)	0.2 (0.1)	12.8 (1.1)
30-39	-	11.7 (2.3)	0.0 (0.0)	11.7 (2.3)	-	9.2 (1.5)	0.0 (0.0)	9.2 (1.5)
40-49	-	12.1 (1.3)	0.3 (0.1)	12.7 (1.5)	-	13.3 (1.1)	0.2 (0.1)	13.8 (1.1)
50-59	-	15.7 (1.6)	0.6 (0.2)	17.0 (1.8)	-	16.6 (1.3)	0.0 (0.5)	16.8 (1.3)
60-65	-	26.6 (3.4)	0.9 (0.9)	28.6 (3.8)	-	18.7 (2.0)	0.1 (0.1)	19.0 (2.0)
19-65	-	15.5 (0.9)	0.4 (0.1)	16.4 (0.9)	-	13.9 (0.6)	0.1 (0.0)	14.2 (0.6)

SR: self-report; AT: accelerometer-total; AB: accelerometer-bout; MVPA: moderate to vigorous physical activity

> Self-report(SR) outcomes:
> ✓ SR moderate PA: moderate(activity at work + travel to and from places + recreational activities)
> ✓ SR vigorous PA: vigorous(activity at work + recreational activities)
> ✓ SR moderate to vigorous PA: 1 minute of vigorous intensity physical activity counts as 2 minutes of moderate intensity physical activity → [moderate PA + vigorous PA ×2]
> ✓ Adherence to PA recommendations : 600MET-minutes/week
> → [(moderate PA × 4METs) + (vigorous PA × 8METs)] ≥ 600METs

Table 4. Proportion (% and SE) of the population attaining sufficient physical activity guideline according to SR, AT, and AB

Approach	Age	Males	Females	Total
SR	19-29	77.7 (4.6)	64.3 (4.2)	69.5 (3.1)
	30-39	57.2 (4.8)	59.4 (3.7)	58.6 (2.9)
	40-49	51.5 (4.4)	50.6 (3.2)	50.9 (2.6)
	50-59	62.1 (4.1)	43.6 (3.0)	50.1 (2.4)
	60-65	60.9 (6.1)	54.5 (5.0)	57.0 (3.8)
	19-65	60.8 (2.1)	52.7 (1.6)	55.6 (1.3)
AT	19-29	67.9 (0.5)	51.9 (0.4)	58.0 (0.3)
	30-39	64.4 (0.4)	37.1 (0.3)	47.3 (0.2)
	40-49	62.6 (0.4)	51.0 (0.3)	55.0 (0.2)
	50-59	62.1 (0.4)	55.2 (0.3)	57.6 (0.2)
	60-65	73.4 (0.5)	63.6 (0.4)	67.4 (0.3)
	19-65	65.0 (0.2)	51.1 (0.1)	56.1 (0.1)
AB	19-29	23.4 (0.4)	17.0 (0.3)	19.5 (0.2)
	30-39	10.5 (0.3)	9.7 (0.2)	10.0 (0.1)
	40-49	15.8 (0.3)	20.7 (0.2)	19.0 (0.2)
	50-59	25.7 (0.3)	27.0 (0.2)	26.6 (0.2)
	60-65	42.1 (0.6)	32.3 (0.4)	36.1 (0.3)
	19-65	21.9 (0.1)	21.2 (0.1)	21.4 (0.1)

SR: self-report; AT: accelerometer-total; AB: accelerometer-bout

CONCLUSIONS

> Self-reported physical activity level by questionnaire had more MVPA than the accelerometer-determined physical activity.
> The adherence rate of the physical activity guideline differed from accelerometer and self-report. The difference was significantly increased when comparing AB with the self-report.
> Great care must be taken when interpreting self-reported physical activity in clinical practice, public health program design and evaluation, and epidemiological research.

REFERENCES

1. Hyo Lee, M. L., Ji-yeop Choi, Kyungwon Oh, Yoonjung Kim, Soyeon Kim. (2018). Knhanes actigraph raw data processing. [KNHANES Actigraph Raw Data Processing]. The Korean Journal of Measurement and Evaluation in Physical Education and Sport Science, 20(2), 83-94.
2. Korea Centers for Disease Control and Prevention. (2015). KNHANES regulation for using of raw data 6th (2013-2015) Retrieved from https://knhanes.cdc.go.kr/knhanes/sub03/sub03_06_02.do
3. Troiano, R. P., Berrigan, D., Dodd, K. W., Masse, L. C., Tilert, T., & McDowell, M. (2008). Physical activity in the united states measured by accelerometer. Medicine and Science in Sports and Exercise, 40(1), 181-188.
4. World Health Organization.. (2010). Global physical activity questionnaire (gpaq) analysis guide. Retrieved from https://www.who.int/ncds/surveillance/steps/resources/GPAQ_Analysis_Guide.pdf