Table 6. Comparison between predicted METs from each equation and measured METs (n = 68).

	Standard equation				Multiple regression equation				Measured METs		ANOVA
	Predicted METs		Difference*		Predicted METs		Difference*				
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Nonlocomotive											
desk work	1.32	0.06	0.17	0.11	1.32	0.29	0.17	0.28	1.15	0.10	St, Mu>Me
Nintendo DS	1.30	0.04	0.18	0.10	1.30	0.28	0.28	0.27	1.12	0.09	St, Mu>Me
sweeping up	3.23	0.58	0.25	0.55	3.21	0.57	0.24	0.41	2.97	0.57	St, Mu>Me
clearing away	2.81	0.41	−0.23	0.58	2.80	0.46	−0.25	0.48	3.05	0.60	Me>St, Mu
washing the floor	3.98	0.48	−0.65	0.88	3.96	0.46	−0.66	0.70	4.62	0.78	Me>St, Mu
throwing a ball	4.20	0.80	0.53	0.60	4.19	0.80	0.53	0.47	3.69	0.65	Mu, St>Me
Locomotive											
climbing down	2.96	0.35	0.67	0.42	2.92	0.48	0.64	0.42	2.31	0.26	S, Mu>Me
climbing up	2.39	0.33	−2.91	0.74	2.39	0.52	−2.94	0.57	5.30	0.69	Me>S, Mu
normal walking	2.66	0.21	0.10	0.34	2.64	0.44	0.05	0.33	2.56	0.27	NS
brisk walking	3.34	0.34	0.16	0.36	3.29	0.45	0.09	0.32	3.16	0.33	S>Me
Jogging	6.69	0.59	0.26	0.99	6.46	0.76	0.02	0.75	6.43	1.04	NS

*Mean and SD mean the difference between predicted METs from each equation and meausred METs.

METs; metabolic equivalents, SD; standard deviation, ANOVA; analysis of variance, NS; not significant; St, standard equation; Mu, multiple regression equation; Me, measured.

>(a sign of inequality) means a significant difference among equations.

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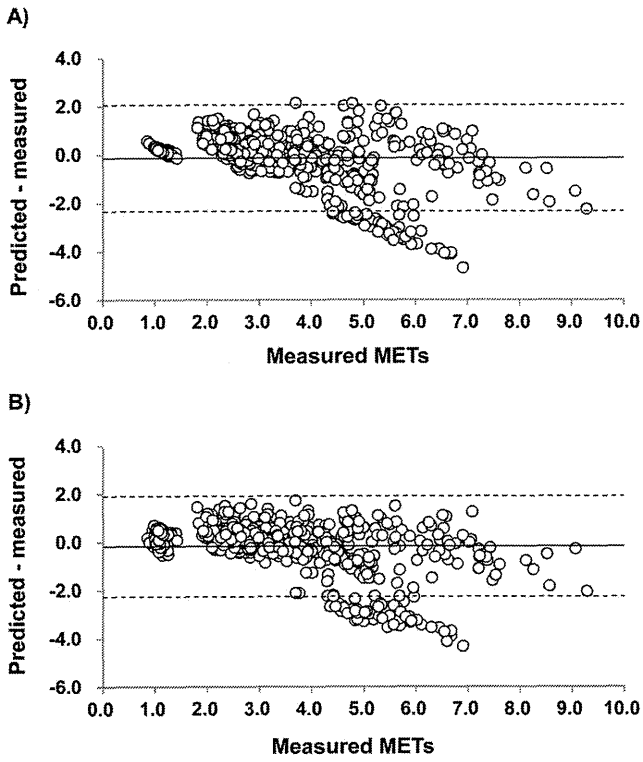

Figure 3. Differences between predicted and measured METs from each equation by Bland and Altman plot analysis. The solid line represents mean differences between measured and predicted values. The 2 dashed lines represent the upper and lower limits of agreement, calculated as mean difference ±2 SD. Upper figure (A) and lower figure (B) shows the standard equation's plots and the multiple regression equation's plots, respectively.
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In the present study, we also found that the adjusted determination coefficient (R^2) and the root mean square error (RMSE) were slightly better when weight, chronological age, and sex were added as independent variables into the standard predictive equations when combining the development group with the cross-validation group (Table 5). However, we did not observe significant differences between the multiple regression equation and the standard equation (not controlled) when looking at the average prediction error for each activity (Table 6). As this would mean that the integrated acceleration from the three dimensions associated with a child's motion includes the effects of biological factors, it might not be necessary to control for weight, age, and sex, similar to several other calibration studies [15,16].

Limitations

Given the limitations of this study, we must be very careful when interpreting our results. We cannot conclude that this predictive model is superior to previous calibration models proposed using common devices, because we did not directly compare our model to other models using the same experimental conditions (i.e. device, ethnic group, targeted activities, and calculation of energy expenditure in the resting state). To truly prove superiority, it would be necessary to compare the different methods under free-living conditions. Furthermore, in the future, we must determine whether our developed model is applicable for estimating PAs not including calibration tasks, because the predictive accuracy of the existing model is significantly reduced when applied to non-calibration activities [17,35].

Conclusions

The results of this study indicate that a specific calibration model that discriminates between nonlocomotive and locomotive activities for children can be useful to evaluate the sedentary to vigorous PAs of both nonlocomotive and locomotive activities. One of the main reasons why the differences between predicted and measured METs with our model were smaller than those reported in previous calibration studies using common devices may be the model's high rate of correct discrimination between locomotive and nonlocomotive activities.

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Author Contributions

Conceived and designed the experiments: YH CT KO KI ST. Performed the experiments: YH CT KO KI ST. Analyzed the data: YH YO. Contributed reagents/materials/analysis tools: YH CT YO ST. Wrote the paper: YH ST.

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