Height Measurements to Diagnose Short Stature and Obesity During After-Hours Period is Inefficient

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Research Article

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Abstract

Background: Pediatricians in Japan usually measure child body weight during medical examinations. However, they rarely measure height. There are no reports addressing the efficiency of height measurement at night or on holidays. Our study asked whether height measurements and obesity index calculations during all pediatric visits were efficient.

Methods: We analyzed data collected on patients between the ages of 3 and 10 years who visited a pediatrics department over a 1-month period. We divided the patients into four groups based on when they visited the department: 1) weekday daytime, 2) weekday Semi-night, 3) weekday Mid-night, 4) holiday. The height and the body weight of all patients were measured. This analysis included 1101 patients. The numbers of patients visiting the hospital were 727, 176, 34, and 164 for Day-time, Semi-night, Mid-night, and Holiday visits, respectively.

Resalts: There were no significant differences in ages of children visiting at different times (p=0.211). However, there were significant differences in height among children visiting at different times (p=0.018), with the Mid-night group being the highest. There were no significant differences in the incidence of obesity among patients visiting at different times (p=0.44); however, significant variations were found for BMI %tile among the patients (p=0.03), being significantly lower for the Mid-night group than the others.

Conclusions: We conclude that height measurement to detect short stature (SS) and calculating BMI to detect obesity is inefficient for children who visit hospital during emergency times.

Introduction

Short stature (SS) is defined as height of -2.0 standard deviations (SD) or less than children of the same sex and age. Height assessment is important, as 5% of SS cases are treatable, such as in growth hormone deficiency (GHD), Turner's syndrome in females [1], malnutrition, and abuse during childhood. SS is typically found through information from parents, multiple checkups, and visits to pediatrics departments. In Japan, it is common practice for pediatricians to measure child body weight. However, they do not always measure child height during examinations conducted in daytime. Furthermore, pediatricians may not measure child height at all during examinations at night or on holidays. Therefore, SS cases may be overlooked despite examination. There are no reports concerning the efficiency of pediatric height measurements at medical examination, especially during night-time visits or holidays. Our study asked whether pediatric height measurements and obesity index calculations are efficient in the context of patients visiting at different times of the day, and weekdays vs. holidays.

Methods

We recruited patients analyzed data collected on patients who can keep still for measuring height between the ages of 3 and 10 years who visited the pediatrics department at Oita Children's Hospital between 1st and 28th February 2016. At hospital reception, hospital staff asked guardians about perinatal information (gestational age, birth weight, height of birth, birth order). The height and body weight of all patients were measured by trained nurses. We excluded some patients who could not record their height and/or weight due to sleeping or poor condition to keep standstill or suspicion of air infection.

The Oita Children's Hospital has 40 beds for mainly primary care and secondary emergencies; it does not have an intensive care unit. We divided the patients into four groups based on when they visited the department: 1) weekday–day, 2) weekday–semi-night, 3) weekday–mid-night, 4) holiday. Weekdays were Monday to Friday; holidays included Saturday, Sunday, and national holidays. Daytime was defined as 9 am to 5 pm, Semi-night as 5 pm to 12 pm, and mid-night as 12 am to 9 am. Weekday–semi-night, weekday–mid-night, and holiday visits were considered as “emergency” visits. We defined obesity as a body mass index (BMI) above the 95th percentile[2]. Growth hormone treatment in short stature children born for small for gestational age (SGA) in Japan is defined as a birth condition in which birth weight and height were both bellow the 10th percentile equivalent of the pregnant week, and birth weight or length was bellow the − 2SD equivalent of the pregnant week compared to the birth-week anthropometric standard for delivery, and as a current condition in which height was less than − 2.5 SD of the same sex and age. [3]. Guardians of all patients provided written informed consent.

Statistical analysis

All statical analyses were performed with EZR (Saitama Medical center, Jichi Medical University, Saitama, Japan)[4], which is for R. The normality of the data distribution was analyzed using the Shapiro-Wilk test with alpha set at 0.05. Each height was standardization by age and sex as standardization height (St-Ht) [3]. The parametric continuous variables St-Ht by age and sex was presented as means with standard deviations (SD). Nonparametric continuous variables comprising age, height body weight (in kg) and BMI percentile were presented as medians with interquartile ranges (IQR). Between-group comparisons were conducted using ANOVA for parametric continuous variables and the Kruskal-Wallis test for nonparametric continuous and the Steel test (with daytime as the control). Fisher's exact tests analyzed gender, and incidences of short stature and obesity.

Results

A total of 6205 patients visited Oita Children's Hospital during the study period, including 3449 who were between 3 and 10 years old (55.5%). The guardians of 2936 patients (85%) consented to the child’s data being used. Data from 1835 patients were excluded due to being incomplete: 947 records were missing the height information, 640 records concerned the third visit or more by the same child, 181 records contained neither height nor weight information, and 29 records were missing an identification number. Data from an additional 11 patients were excluded because the patient was either under 3 years or over 11 years of age, 9 records were due to height more than + 10 SD above the mean, and one record was not described at the time of visit (Fig. 1).

We analyzed data from 1101 patients, of which 555 were male (50.4%). The numbers of patients visiting the hospital were 727, 176, 34, and 164 during daytime, semi-night, mid-night, and holidays, respectively. The mean age of patients was 6.18 ± 2.14 years. There was no significant age variation among groups visiting the hospital at different time zone ($p = 0.211$).

The data for St-Ht were normally distributed, with an overall mean of 0.17 ± 1.13 (Fig. 2). The mean St-Ht of children visiting at each time zone were 0.16 ± 1.18, 0.11 ± 1.04, 0.76 ± 0.85, and 0.23 ± 1.09 for daytime, semi-night, mid-night, and holidays, respectively (Fig. 3). There were significant differences related to times of visiting ($p = 0.018$). More specifically, the mean value for the mid-night group was significantly higher than for the other groups.

The number of patients recorded as obese based on body weight was 55 (4.99% of 1101). Within this patient group, the numbers visiting during daytime, semi-night, mid-night and holidays were 33 (4.53% of Daytime visitors), 13 (7.38% of Daytime visitors), 2 (5.88% of Daytime visitors) and 7 (4.26% of Daytime visitors), respectively. There were no significant differences in the incidence of obesity among patients presenting at different times ($p = 0.44$).

The BMI percentile data were not normally distributed. The overall median BMI percentile was 59.2 (IQR: 36.6–78.8), and 59.9 (IQR: 38.1–79.1) for daytime visits, 64.8 (IQR:37.7-82.95) for semi-night visits, 46.3 (IQR:29.9–76.6) for mid-night visits, and 53.8 (IQR:32.0-73.5) for holidays visits. There were significant differences among these values ($p = 0.03$). When we compared the groups, the mean value for the mid-night group was significantly low (Table 1).

Table 1
The characteristics of participants for each time zone. BW; body weight, F; female, SD; standard deviations, IQR; interquartile ranges, kg; kilogram, M; male, N; number, St-Ht; standardization height, y; years.

		Day-time	Semi-night	Mid-night	Holiday	P
Gender (N)	M	368	86	17	84	0.973
	F	359	90	17	80	
Age(y)	Median	6.10	5.75	5.8	5.6	0.138
	IQR	4.6–8.1	4.1–7.5	4.5-8.0	4.5–7.5	
In Male	Median	6.00	5.80	6.70	5.70	0.73
	IQR	3.0-11.1	3.2–10.8	3.5–12.2	3.0-10.9	
In Female	Median	6.1	5.7	5.7	5.5	0.13
	IQR	3.0-11.1	3.0–11.0	3.4–11.1	3.0-10.7	
Height(cm)	Median	113.50	111.40	116.0	112.22	0.146
	IQR	13.88	13.77	14.33	13.93	
St-Ht	Mean	0.16	0.11	0.76	0.22	0.018
	SD	1.17	1.03	0.85	1.08	
In Male	Mean	6.28	6.10	6.48	6.24	0.872
	SD	2.01	2.14	2.19	2.18	
In Female	Mean	6.45	5.98	6.20	5.94	0.132
	SD	2.24	2.24	2.40	2.05	
BW (kg)	Median	19.5	18.85	20.35	18.65	0.187
	IQR	16.20–23.40	16.00-23.92	16.92–24.02	15.80-22.62	
BW (percentile)	Median	59.90	64.80	46.3	53.85	0.031
	IQR	28.15–78.9	37.90-82.85	31.72–74.40	32.20-72.175	
In Male	Median	60.0	64.05	44.00	57.65	0.520
In Female	Median	59.90	65.15	46.90	50.45	0.058
Short stature	N	22	3	0	7	0.57
Obesity	N	33	13	2	7	0.44

In total, 330 patients were available for the evaluation of the SGA. The SGA was in 8, and the growth hormone treatment in short stature children born for the SGA was in 1.

Discussion

The results of this study suggested that pediatric height measurements or obesity index calculations at patient visits to evaluate SS and/or obesity during after-hours period were inefficient.

In Japan, due to the universal health insurance system the examination fee is modest and almost the same for visits during emergency and regular times. Non-emergency patients sometimes visit the hospital at various times during the day due to parental anxiety [5, 6]. Social and economic factors in the family, education, and health care awareness may all increase the incidence of emergency visits [7]. Furthermore, children classified as being in poverty had more emergency time hospital visits [8]. We considered the possibility that a higher proportion of the patients visiting during emergency time had SS due to poor nutrition. We think it might be possible to find children with SS that had previously gone undetected. Our results do not show more children with SS as a function of the time of emergency. We reasoned that the height distributions would be normal for all visiting times. However, the absence of patients with SS during mid-night visits might reflect the small number of such visits. With more mid-night visits the number of SS cases may also increase. During emergency times hospitals are staffed by a limited number of doctors, nurses, and other personnel. Measurering the height of unwell children when medical resources are limited is inefficient.

We expected that the numbers of obese patients at emergency times would be high, but this was not the case; the BMI distribution appeared normal. Although caution is required in view of the small number of emergency time visits, we also suggest that calculating BMI, given the limited resources available during emergency times is inefficient.

The prevalence of SGA in Japan was 3.5%, and the estimated percentage of SGA cases that meet the criteria for GH treatment was 0.06% [9]. Our study found one short stature child born for the SGA that can be treated by the GH. Perinatal information was collected in only 330 out of 1101 patients in this study, namely estimated percentage of SGA cases that meet the criteria for GH treatment was bellow 0.09–0.30%, which appears to be equivalent with previous reports. It is inefficient to detect short stature children born for SGA that can be treated with GH treatment during emergency time.

There were several limitations to this study. First, we focused on pediatric examinations in a single hospital, for only one month. Because patient characteristics change across the seasons, it would be valuable to extend such a study throughout the year. Similarly, some patient characteristics might vary across geographical regions, and so regional factors should be considered. Second, our study excluded patients under 3 years old and over 10 years old. We intended to measure height exactly with a standing position. So, we do not know if Mid-night measurements are suitable or effective for patients in those two age categories. Third, only 31.9% of the target-age patients who visited the hospital had their height measured. We excluded the patients who could not measuring height and/or weight exactly with a standing position. The excluded patients are poor condition, emergency condition, sleeping or suspicion of air infection. Therefore, there might be more cases of SS and obesity patients than we were able to detect. Finally, outcomes may be different depending on how many patients the hospital receives during emergency times; a hospital receiving hundreds might produce a different picture than one receiving relatively few.

Conclusion

The height measurement to detect SS and calculating BMI to detect obesity for children who visit the hospital during after-hours is inefficient.

Abbreviations

GHD
Growth hormone deficiency
BMI
Body mass index
SD
standard deviations
SGA
Small for gestational age
SS
short stature
St-Ht
standardization height

Declarations

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Conflicts of interest/Competing interests; Not applicable.

Data availability: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Code availability; Not applicable.

Authors' contributions: SY conceived the study and was involved in the interpretation of the data and refine the manuscript. TF participated in its design and coordination. KU participated in its design and in the study design and collected the data. TM performed the statistical analyses, interpretation of the data, and drafted the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate: The study was approved by the Ethical Committee of the Oita Children's Hospital (approval number 2016-1). Guardians of all patients provided written informed consent.

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Figures

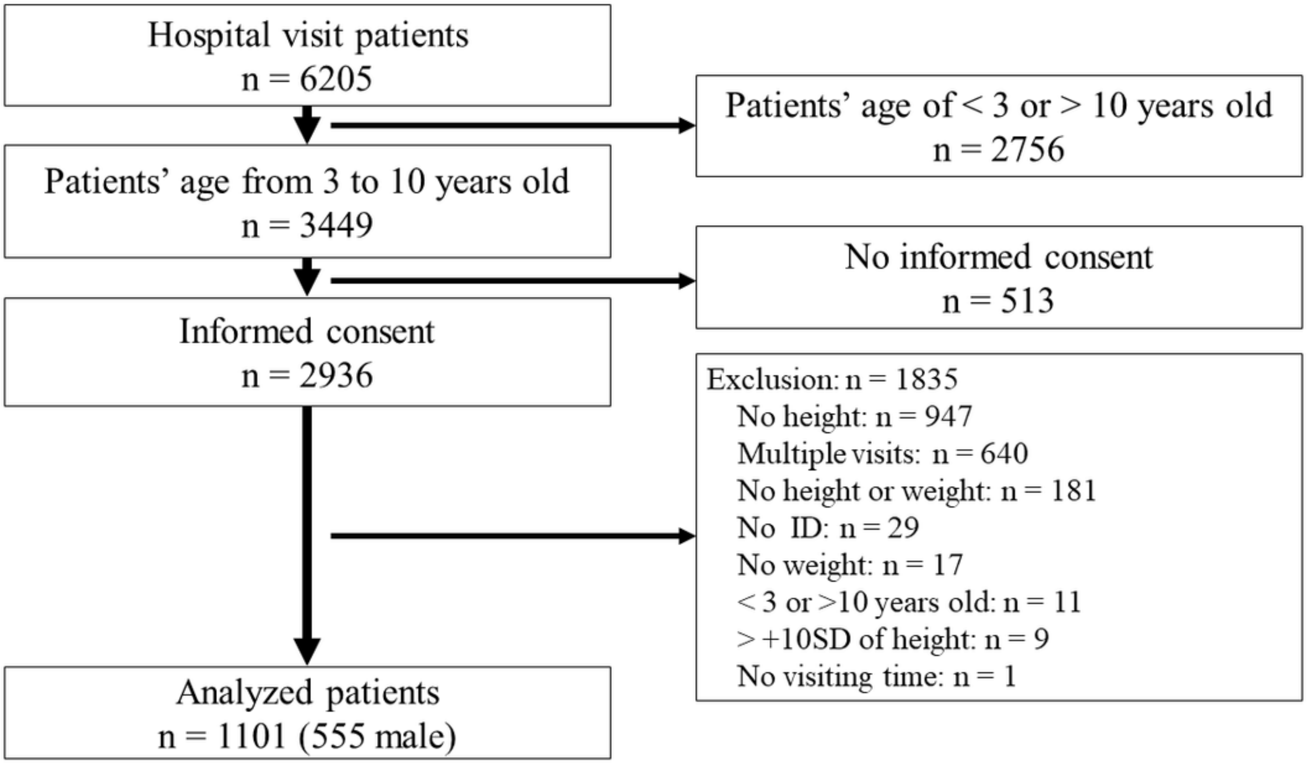

Figure 1

A flow chart of the study participants. ID; identification, n; number, SD; standard deviations.

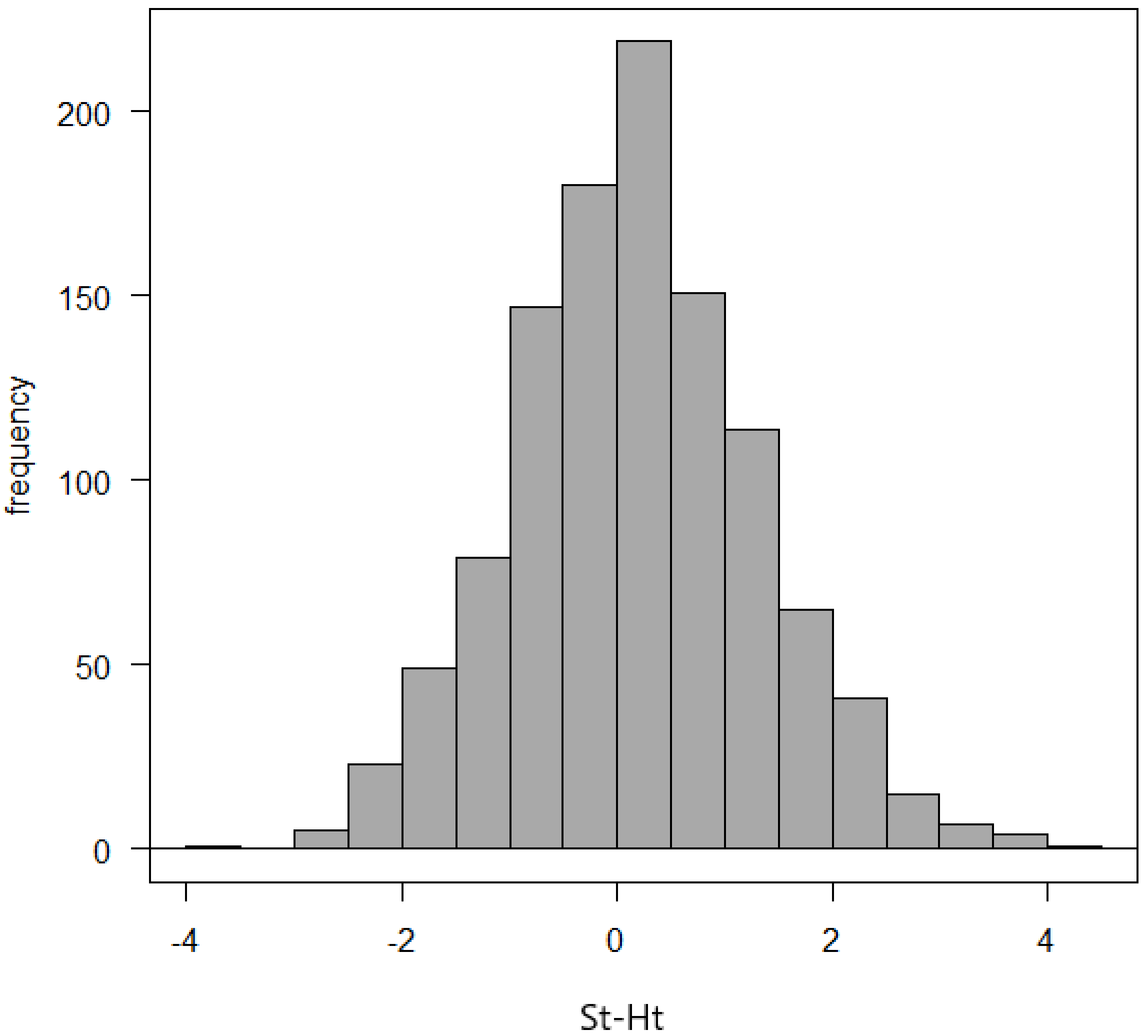

Figure 2

The distribution of height for participants. St-Ht; standardization height.

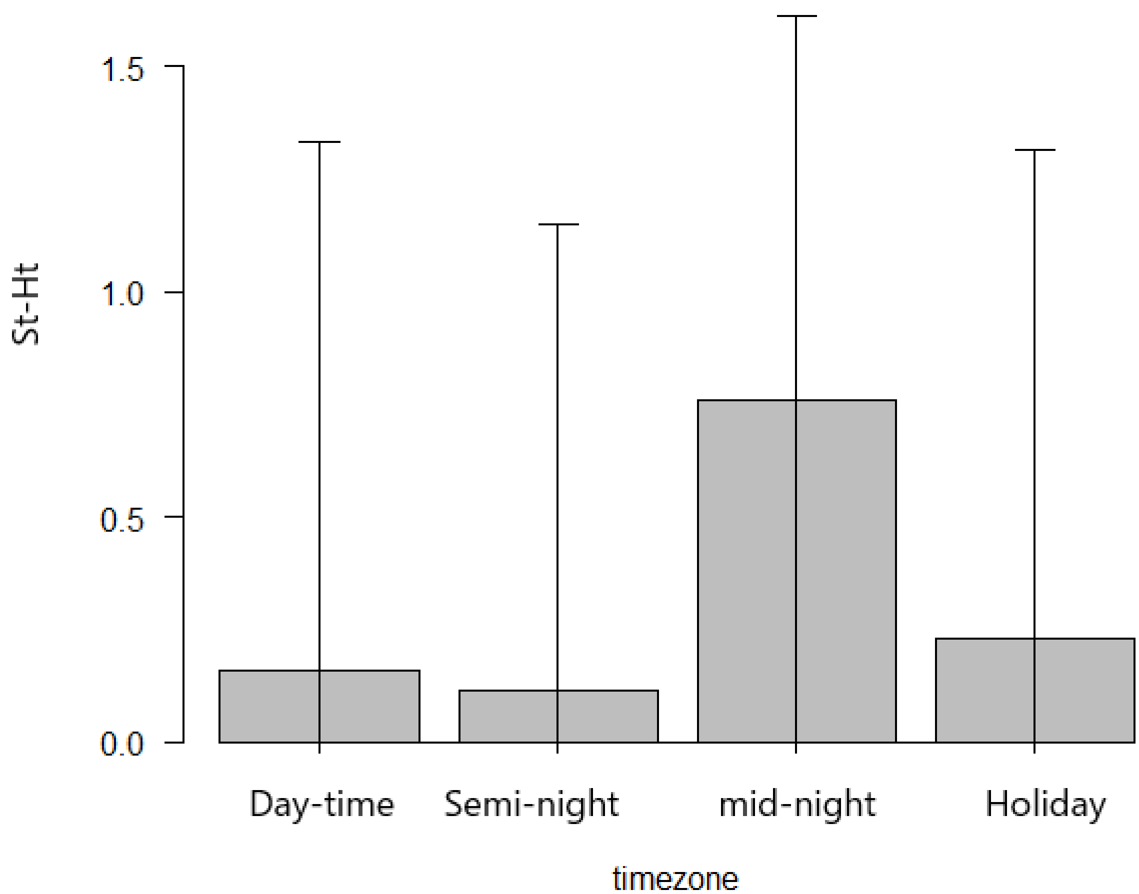

Figure 3

The box plots of standardization height for each time zone. St-Ht; standardization height.