Risk Management and Healthcare Policy

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ORIGINAL RESEARCH

Accuracy of Caregiver-Reported Height, Weight, and BMI in a Pediatric Growth Clinic

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Objective: To evaluate the accuracy of caregiver-reported height, weight, and body mass index (BMI) in children attending a pediatric growth clinic, and to explore the impact of these errors on clinical management and telemedicine.

Methods: This cross-sectional study included 132 children aged 6–12 years attending a pediatric growth clinic. Caregivers reported their children's height and weight, and standard measurements were taken within one week. BMI was calculated for both sets of data. Differences between caregiver-reported and standard measurements were analyzed across gender and age. Bland-Altman and linear regression analyses assessed agreement and correlation.

Results: Caregivers slightly overestimated height (+0.6 cm) and underestimated weight (−0.9 kg), resulting in an underestimation of BMI (−0.6 kg/m², $p < 0.001$). About 4.5% of overweight children were misclassified as non-overweight. Measurement errors showed no significant differences by gender or age group. Most caregivers measured their children's height and weight approximately once per month, regardless of subgroup. Despite minor discrepancies, caregiver-reported and standard data were strongly correlated ($R^2 > 0.9$). Bland-Altman analysis revealed good agreement, though height had slightly lower concordance.

Conclusion: While caregiver-reported measurements exhibited minor errors, the magnitude was comparable to previous findings in general pediatric populations. Thus, caregiver-reported data may be suitable for follow-up monitoring in pediatric growth clinics but should be used cautiously for initial diagnosis or therapeutic decisions.

Keywords: caregiver-reported, measurement error, pediatric growth clinic, telemedicine

Introduction

In China, pediatric growth clinics, as a kind of specialized medical services that have gradually emerged in recent years, are mainly for children with growth deviations or abnormalities, such as short stature, precocious puberty, and obesity.[1] These clinics provide comprehensive health management, including medical evaluation, nutritional guidance, and lifestyle interventions. Given the complexity of growth patterns in these children compared to the general children, their management relies heavily on accurate physical measurements and long-term monitoring to optimize growth evaluation and treatment.[2,3] Height, weight and body mass index (BMI) are fundamental indicators for assessing growth in pediatric patients and are seemingly easy to measure independently by most families.[4,5] Therefore, with the development of telemedicine, caregivers are increasingly required to monitor children's growth at home and report the results to clinicians for evaluation. However, previous studies have demonstrated errors in caregiver measurements, with a tendency to overestimate height and underestimate weight. These errors can lead to misjudgments of growth status.[6,7] Notably, these studies have primarily focused on the general children, whereas data on measurement errors specific to children attending growth clinics remain limited. For children in these clinics who rely on remote follow-up for long-term management, measurement errors could further affect disease monitoring plans and intervention strategies. Our study aims to evaluate the discrepancy between caregiver-reported and standard measured height, weight and BMI among children attending growth clinics. Furthermore, it explores the potential impact of these measurement errors on telemedicine follow-up and clinical management, providing data to

Received: 24 April 2025
Accepted: 28 July 2025
Published: 8 August 2025

supporting the remote monitoring system. This may help enhance the quality of remote clinical decision-making and ultimately improve patient outcomes through more accurate growth assessment and timely intervention.

Methods

Study Participants

This study is a descriptive cross-sectional study. Data were collected from children aged 6–12 years who were first-time visitors to pediatric growth clinic at Beijing Jishuitan Hospital, Capital Medical University, between January 2024 and December 2024.

Inclusion criteria: 1) school-age children aged 6–12 years old who were health and did not have severe neurodevelopmental disorders; 2) first time visit to the pediatric growth clinic at our hospital; 3) caregiver with no cognitive or communication impairments; 4) informed consent was obtained from both caregivers and children, who voluntarily participated in the study. Exclusion criteria: 1) children who had undergone physical measurements at medical institution within 3 months; 2) children with known genetic or chronic diseases related to growth and development.

Ethical approval for this study was obtained from the Beijing Jishuitan Hospital, Capital Medical University, Beijing, China (approval number: K2024-195-00). All data collection was conducted with written informed consent from caregivers. Additionally, for children aged 8 years or older, assent from the child was also obtained. All participants provided signed informed consent. All data were handled in compliance with applicable data protection regulations, and confidentiality was strictly maintained throughout the study. This study complies with the ethical principles outlined in the Declaration of Helsinki.

Data Collection

General Information

A self-designed questionnaire was used to collect demographic and clinical information, including gender, age, daily living habits and family history.

The survey was administered in Mandarin. Upon arrival at the clinic, caregivers were invited to participate in a face-to-face, one-on-one interview conducted by pediatric nurses who had received standardized training. The interviews were conducted in a quiet consultation room to ensure privacy and clarity. Participation was entirely voluntary, and no financial or material incentives were provided to the respondents.

Caregiver-Reported Physical Measurements

Previous studies have shown that height and weight measurements may vary at different times of the day.[8] Therefore, within one week before the clinic visit, staff members contacted caregivers by phone to instruct them to measure their children's height and weight at home between 6:00 and 9:00 AM. During clinic visits, caregivers provided self-measured height and weight data through face-to-face interviews conducted by trained nurses. BMI was subsequently calculated based on these reported values Height was recorded in centimeters (cm), accurate to 0.1 cm, and weight was recorded in kilograms (kg), accurate to 0.1 kg.

Standard Medical Measurement

Measurements were taken by trained pediatric nurses, and the time period for measurements was the same as caregiver-reported measurements. Medical measurements were taken within 1 week of the caregiver-reporting data, and were recorded in the same way the caregiver-reporting. Measurements were taken using a calibrated medical measuring scale (Seco gmbh&co.kg).

Group Analysis

Participants were divided into boy group and girl group. Additionally, to enable more detailed analysis, participants were further stratified by age into lower grade group (6–8 years) and upper grade group (9–12 years).

Statistical Analysis

Data were analyzed using Python 3.8.0. Continuous variables were presented as mean ± standard deviation (SD), while categorical variables were presented as counts (percentages). Paired t-tests were used to analyze differences between standard measurements and caregiver-reported data. Independent sample t-tests were used to compare differences between subgroups. For agreement analysis between the two measurement methods, continuous data were assessed using the Bland-Altman method. The bias (mean difference) was calculated as the mean of standard measured minus caregiver-reported data. The 95% limits of agreement (LOA) were defined as Bias±1.96SD. Agreement was considered poor if >5% of data points fell outside the 95% LOA. A P-value<0.05 was considered statistically significant. Linear regression analysis was performed to evaluate the relationship between caregiver-reported data and standard measurements. A regression equation was calculated to quantify bias in measurement errors.

Results

Demographic Characteristics

A total of 132 children were included in this study, comprising 62 boys (47.0%) and 70 girls (53.0%). In terms of age distribution, 85 (64.4%) belonged to the lower grade group, while 47 (35.6%) belonged to the upper grade group. BMI was calculated based on both caregiver-reported and standard measured height and weight. BMI classifications were determined using age- and gender- specific percentiles.[9] Details are shown in Table 1.

Comparison Between Caregiver-Reported and Standard Measured Data

We compared caregiver-reported and standard measured data (Table 2). Overall, caregiver-reported height was overestimated, while caregiver-reported weight and BMI were underestimated (p<0.001).

In the gender group analysis, both boys and girls showed a similar pattern of height overestimation and weight underestimation. However, the degree of height overestimation was more pronounced in boys (p=0.003), whereas girls had a less extent (p=0.035). Additionally, both genders demonstrated significant underestimation of weight, leading to lower BMI calculation compared to standard measurements (p<0.05).

Similarly, in the age group analysis, both lower and upper grade groups demonstrated a consistent trend of height overestimation and weight/ BMI underestimation (p<0.05).

In addition, we categorized the intervals between home measurements into four groups: less than 1 month, about once per month, once every 3–6 months, and more than 6 months. We compared the measurement frequency across different subgroups. Results showed that most caregivers of children attending the pediatric growth clinic measured their children approximately once per month (45.7% for boys, 53.7% for girls, 52.9% for lower grade, and 48.9% for upper grade). No significant differences were found in measurement frequency across gender ($\chi^2 = 4.03$, p = 0.259) or age groups ($\chi^2 = 1.38$, p = 0.710).

Table 1 General Information About the Study Participants

Classification		Number
Gender	Boys	70
	Girls	62
Age	Lower grade (6–8 years)	85
	Upper grade (9–12 years)	47
Caregiver-reported BMI	Underweight or normal	97
	Overweight	20
	Obesity	15
Standard measured BMI	Underweight or normal	91
	Overweight	22
	Obesity	19

Abbreviation: BMI, body mass index.

Table 2 Comparison Between Caregiver-Reported and Standard Measured Data ($\bar{x} \pm s$)

Indicator	Caregiver-Reported	Standard-Measured	t	p
General				
Height (cm)	131.4±14.0	130.8±13.8	3.762	<0.001**
Weight (kg)	29.5±10.9	30.4±11.2	−7.961	<0.001**
BMI (kg/m^2)	16.6±3.1	17.2±3.1	−8.924	<0.001**
Gender				
Boys				
Height (cm)	131.9±14.4	131.2±14.2	3.103	0.003**
Weight (kg)	31.2±12.3	32.1±12.7	−6.105	<0.001**
BMI (kg/m^2)	17.3±3.4	18.0±3.6	−6.538	<0.001**
Girls				
Height (cm)	130.7±13.6	130.3±13.5	2.153	0.035*
Weight (kg)	27.6±8.9	28.5±8.9	−5.123	<0.001**
BMI (kg/m^2)	15.8±2.4	16.4±2.3	−6.032	<0.001**
Age				
Lower grade				
Height (cm)	123.3±8.6	122.9±8.7	2.305	0.024*
Weight (kg)	24.4±6.8	25.1±6.9	−5.684	<0.001**
BMI (kg/m^2)	15.8±2.5	16.4±2.5	−6.297	<0.001**
Upper grade				
Height (cm)	145.9±9.3	145.1±9.2	3.167	0.003**
Weight (kg)	38.8±10.9	40.0±11.2	−5.695	<0.001**
BMI (kg/m^2)	18.0±3.4	18.8±3.5	−6.829	<0.001**

Notes: *P<0.05; **P<0.01.
Abbreviation: BMI, body mass index.

Comparison of Measurement Errors

The comparison of measurement errors showed that differences in height, weight, and BMI between boys and girls were minimal ($p > 0.05$). In the age group analysis, although the upper grade group exhibited slightly larger errors in all physical measurements compared to the lower grade group, the differences were small ($p > 0.05$). Details are shown in Table 3.

Table 3 Comparison of Measurement Differences Between Groups ($\bar{x} \pm s$)

Indicator	Classification		t	p
Gender	Boys	Girls		
Height difference (cm)	−0.7±1.8	−0.5±1.7	−0.714	0.447
Weight difference (kg)	0.9±1.3	0.9±1.4	0.116	0.908
BMI difference (kg/m^2)	0.7±0.9	0.6±0.8	0.359	0.720

(*Continued*)

Table 3 (Continued).

Indicator	Classification		t	p
Age	Lower grade	Upper grade		
Height difference (cm)	−0.4±1.7	−0.8±1.8	1.296	0.197
Weight difference (kg)	0.8±1.3	1.1±1.4	−1.468	0.144
BMI difference (kg/m^2)	0.6±0.9	0.7±0.7	−0.696	0.487

Notes: measurement difference = standard measured data - caregiver-reported data.
Abbreviation: BMI, body mass index.

Consistency Analysis Between Caregiver-Reported and Standard Measured Data

The Bland-Altman analysis indicated that the LOA for height differences ranged from −4.00 to 2.85 cm, with 6.8% of the data points falling outside the 95% LOA. The LOA for weight ranged from −1.66 to 3.47 kg, with 3.8% of data points exceeding the 95% LOA. Similarly, for BMI differences, the LOA were −1.03 to 2.38 kg/m^2, with 5.3% of data points outside the 95% LOA. Detailed results are presented in Figure 1.

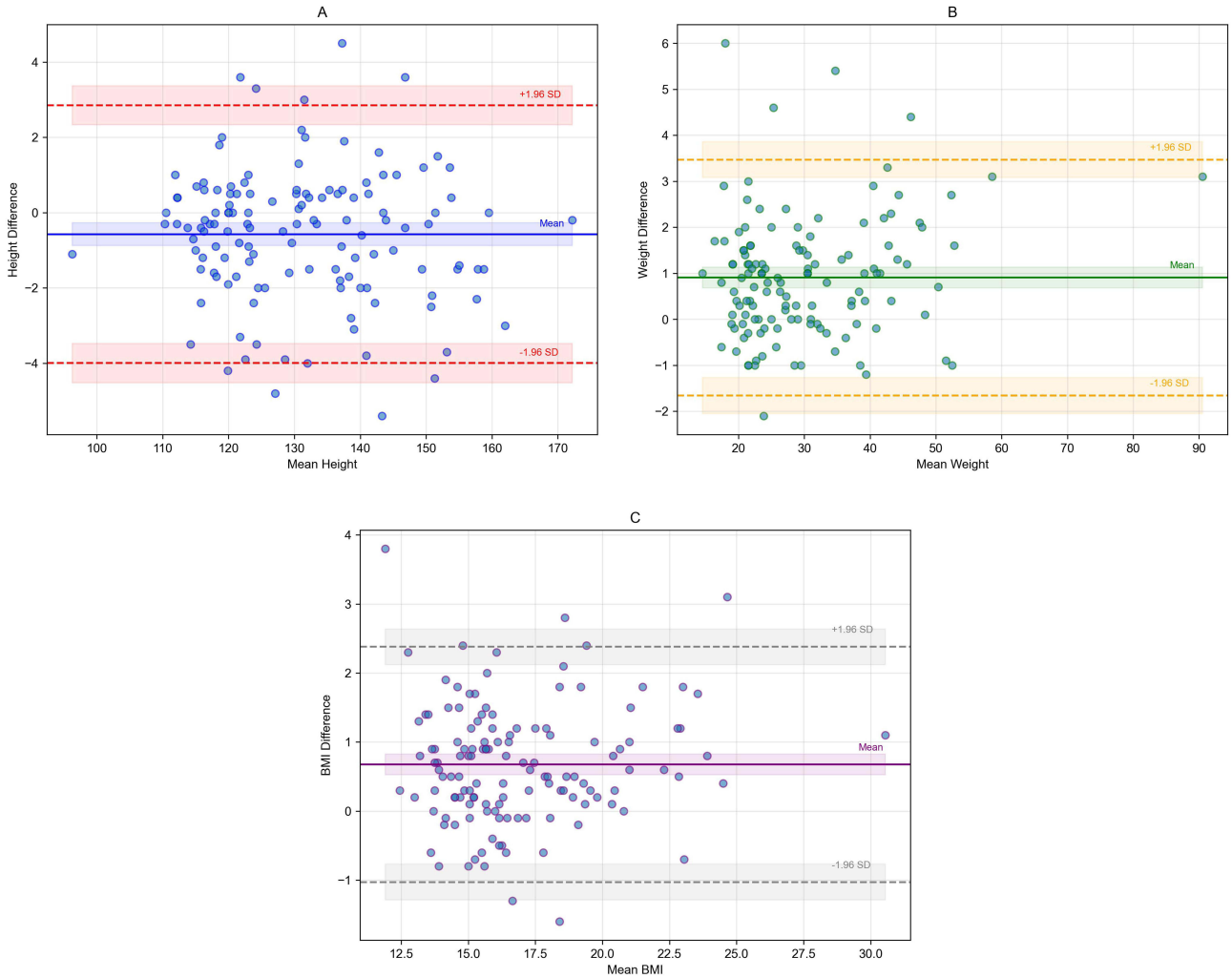

Figure 1 Bland-Altman Analysis of Agreement Between Caregiver-Reported and Standard Measured Data. (**A**) Height difference, (**B**) Weight difference, (**C**) BMI difference.
Abbreviations: BMI, body mass index; SD, standard deviation.

https://doi.org/10.2147/RMHP.S529963

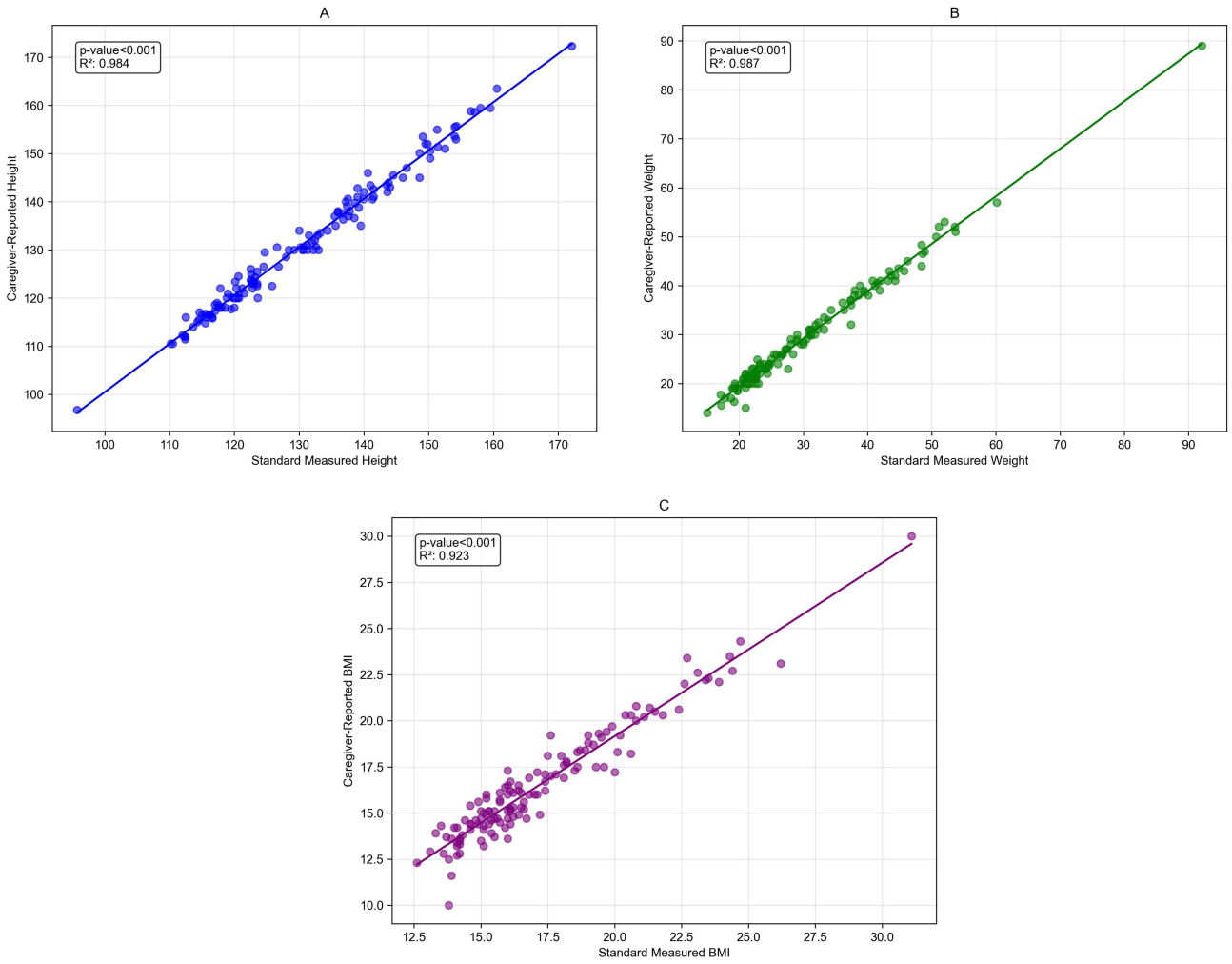

Figure 2 Linear Correlation Between Caregiver-Reported and Standard Measured Data. (**A**) Height, (**B**) Weight, (**C**) BMI.
Abbreviation: BMI, body mass index.

Correlation Analysis Between Caregiver-Reported and Standard Measured Data

Scatter plots showed a strong linear correlation between caregiver-reported data and standard measured data (Figure 2). Subsequently, linear regression analysis was performed to establish correction equations for caregiver-reported data.

Caregiver-reported height = 0.168 + 1.003 × standard measured height

Caregiver-reported Weight= −0.034 + 0.971 × standard measured weight

Caregiver-reported BMI = 0.361 + 0.940 × standard measured BMI

Discussion

In recent years, telemedicine has rapidly expanded in China, and has become an important part of the healthcare system. As of June 2023, the number of Internet medical users in China has reached 364 million people, accounting for 33.8% of the total number of Internet users.[10,11] In the follow-up management of pediatric growth clinics, online consultations have gradually replaced some in-person visits. Caregivers submit their children's growth data through telemedicine platforms, and doctors use these data to make growth assessments and treatment adjustments. The new healthcare model has transformed the role of caregivers from passive recipients of medical care to active participants in their children's health management. Caregivers not only need to measure height, weight and BMI regularly according to medical advice, but also need to monitor the growth trend of their children and communicate any deviations to doctors. This shift aims to enhance individualized intervention strategies and improve long-term health outcomes.[12,13]

However, this shift also brings new challenges. Clinicians rely on home-monitored data provided by caregivers for diagnosis and treatment, but the accuracy of these data maybe affected by caregiver measurement methods or comprehension. Such errors may mislead clinical judgement, affecting the accuracy of disease screening and, in some cases, leading to misinterpretation of children's growth changes, which in turn affects the follow-up planning and intervention decisions.[14,15] Errors in physical measurements may even lead to serious consequences. One study reported that approximately 34% of weight measurement errors resulted in medication dosing mistakes.[16]

Previous studies have generally recognized systematic biases in caregiver-reporting height and weight, typically manifesting as height overestimation and weight underestimation. In Asian adult populations, Roystonn et al found that caregiver-reported height was overestimated by 0.16–0.28 cm, while weight was underestimated by 0.63–1.3 kg.[17] Hodge's research on the US population indicated that approximately 13% of adult males and 7% of adult females were misclassified into lower BMI category due to caregiver-reporting errors.[18] This measurement error, particularly underestimation of weight, has been shown to increase with age.[19] Among children and adolescents, Zhou reported that Chinese caregivers overestimated height by an average of 1.36 cm and underestimated weight by 2.35 kg.[20] Furthermore, studies have consistently shown that the sensitivity of obesity classification based on caregiver-reported data is significantly lower, often leading to an underestimation of overweight rate in children by more than 10%.[21,22]

The psychological mechanisms underlying these errors have been widely recognized. In particular, social desirability bias plays an important role. Individuals tend to report body measurements that align with societal ideals.[23] For instance, shorter individuals may unconsciously exaggerate their height to conform to the common perception that taller stature is favorable. Similarly, caregivers may underreport their children's weight to avoiding labeling them as overweight or obesity.[24–26]

Based on previous studies reporting self-report errors among general populations, we initially hypothesized that caregivers of children attending pediatric growth clinics might exhibit even greater measurement errors due to their high level attention to growth status. However, our study did not support this hypothesis. Our findings indicate that in pediatric growth clinics, caregiver-reported data demonstrated a mean height overestimation of 0.6 cm and a mean weight underestimation of 0.9 kg. Although theses measurement errors were observed, the magnitude of these errors were similar to seen in caregivers of healthy children, without more pronounced errors. Moreover, strong positive correlations were observed between caregiver-reported data and standard measurements, and Bland-Altman analysis indicated good agreement for measurement, which are consistent with previous studies.[27,28] This may be attributed to their greater emphasis on growth monitoring or more frequent use of measurement tools, which could partially offset the errors caused by psychological factors.

Nevertheless, our study also revealed that approximately 4.5% of overweight children were misclassified as non-overweight due to caregivers underestimating weight or overestimating height. Additionally, although height measurement errors were relatively small, Bland-Altman analysis showed slightly poor agreement for height compared to weight. These findings suggest that caregiver-report data can serve as a valuable supplementary tool for understanding general growth trends and supporting follow-up plans and intervention strategies. In other words, caregiver-reported data are more suitable for regular follow-up care rather than for initial disease diagnosis. Moreover, it is important to remain vigilant, as even small errors in reported weight and height can influence clinical decision, particularly in areas such as weight-based medication dosing, nutritional risk screening, or the initiation of growth-related interventions.

A better approach would be to reduce these errors to enhance the accuracy of remote follow-ups. To minimize the impact of these errors, we developed correction formulas in this study to optimize the accuracy of caregiver-reported data. Each correction formula includes a constant and a slope from the regression analysis. The slope shows how closely the caregiver-reported data matches the standard-measured data (a slope closer to 1 means better agreement), while the constant shows any overall bias. Among the three, BMI has the greatest deviation from the ideal. This might be because BMI is calculated from both height and weight, so small errors in both can add up and make the result less accurate. Such correction strategies have been widely used and validated in previous studies, demonstrating their potential to enhance the reliability of caregiver-reported data.[29,30] However, relying only on statistical correction cannot fully eliminate measurement errors. Improving the accuracy of caregiver-reported data remains a critical issue. Fortunately, many studies have confirmed that small adjustments can enhance data accuracy. For example, providing standardized measurement devices or recommending suitable home-use measurement tools can reduce systematic errors. Increasing caregivers'

awareness of the importance of growth monitoring and the impact of measurement errors on health assessments can also reduce subjective errors.[31,32] Furthermore, standard guidance may be more practical and effective. Studies have shown that after caregivers receive simple measurement training, the accuracy of caregiver-reported data improves.[33,34] Therefore, before initiating remote follow-ups for pediatric growth patients, caregivers should receive training and guidance to standardize measurement practices.

Conclusion

This study confirms that parents of children attending growth clinics often overestimate height and underestimate weight, leading to an underestimation of BMI. Caregiver-reported data showed a strong correlation with standard measurements, making it useful for long-term follow-up after diagnosis. However, even small errors can affect growth classification and medication dosing, so such data may not be suitable for initial disease screening or treatment decisions. We proposed correction formulas to reduce these errors, but parent training may be more effective. Our findings highlight both the value and the limitations of using caregiver-reported data in pediatric care, and underscore the importance of improving measurement accuracy in telemedicine.

Abbreviations

LOA, limits of agreement; BMI, body mass index; SD, standard deviation.

Data Sharing Statement

The datasets analyzed during the current study are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

Ethical approval for this retrospective study was obtained from the Beijing Jishuitan Hospital, Capital Medical University, Beijing, China (approval number: K2024-195-00). All data collection was conducted with written informed consent from parents or legal guardians. Additionally, for children aged 8 years or older, assent from the child was also obtained. All participants provided signed informed consent. All data were handled in compliance with applicable data protection regulations, and confidentiality was strictly maintained throughout the study. This study complies with the ethical principles outlined in the Declaration of Helsinki.

Acknowledgments

Thanks all the participants for their involvement in the study.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

Project supported by Beijing JST Research Funding (code: QN202422), which provide financial support in the design of the study and collection, analysis, and interpretation of data and in writing the manuscript.

Disclosure

The authors declare that they have no competing interests in this work.

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