## Research Article

# Most Appropriate Mechanism to Understand the Parental Classification of Child's Weight Status

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**Abstract**

**Background:** Childhood obesity is a problem with long-term health risks. Preschool ages are an ideal period for prevention and intervention strategies but requires parental support. With the frequency of parental misclassification of child weight between 20% and 29% and as high as 81.4% for clinically obese, this is problematic.

**Objectives:** This study examined the three most used methods for determining accurate classification: the Likert scale where parents select a written description, a pictorial method where a visual image is selected, and a written method where parents write the child weight.

**Method:** This cross-sectional study involving 198 parents and children aged 2 to 5, in standalone preschools or child care centers with preschools. Parents completed a questionnaire that included their assessment of their child's weight by all three methods.

**Results:** Highest classification accuracy was found with the Likert method at 53.3% while weight-reporting had 50.3% and the pictorial method had 35.9% accuracy. Kappa values showed that the pictorial method (κ = -0.028, p = 0.42) and Likert scale method (κ = -0.032, p = 0.37) was not significantly better than chance alone. Meanwhile, slight statistically significant agreement was observed with the weight-reporting method (κ = 0.21).

**Discussion:** It is clear that parents are not good at discriminating weight deviation in their children by any method. The disconnect between the parental perception of child weight and the reality of weight needs researched further so appropriate intervention and prevention strategies can be formed for preschool children.

**Keywords:** Obesity; Preschool; Parents; Perception; Misclassification; Weight

## Introduction

Obesity and its comorbid conditions are no longer isolated to adulthood. The National Institute of Health reports that 1 in 6 youth ages 2 to 19 is considered obese [1]. Meanwhile, 1 in 3 adults has obesity [1].

Physical inactivity, poor eating habits, genetics, screen time, inadequate sleep, medications, and access to healthy food or safe places are among factors linked to the trend of increasing rates of weight problems at all ages [2-5]. For youth, their ability to understand the problem and mechanisms to prevent or correct weight problems are linked to their parents.

Initiation of healthy lifestyles, regulation of child diet and exercise for prevention as well as intervention and its success relies on parental influence [6-8]. The ability to provide a positive influence on child weight and appropriate lifestyle, activity, and eating can be hindered or helped by parental awareness of weight-related issues and realistic recognition of child weight [9].

Therefore, it is critical to understand how parents perceive their child's weight status. Research on parental ability to correctly perceive weight has generally shown that parents underestimate child weight [10-12]. Misperception of weight has consistently been identified as a discrepancy between how a parent describes their child versus the actual weight of the child [10,11,14,15]. However, the method of determining the parent view of child weight has varied.

Three different methods for gauging perception have been identified in the literature: use of a Likert scale, use of a pictorial scale, and parental report of child-weight. The Likert scale method of having parents select a written description of their child's weight has been used in most studies, though the visual scale has been used as well. Both were identified as the most common methods found in two large meta-analyses [13,16] and another literature review [17]. Neither visual or non-visual assessments were deemed a significant moderator of parental underestimation of child weight in obese and overweight children, though it was significant in normal-weight children when looking at 69 articles encompassing 78 samples, n = 15,791 [16]. Meanwhile, Gordon and Mellor [11] were one of a handful of studies that used parental self-report of child weight to determine the accuracy of parental perception.

Despite the prevalent research examining parental misperception,

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no original research was identified that used a single sample to compare the perception of weight using all three methods and determine if one has improved accuracy and validity for use in research. This study's purpose was to mirror how these tools have been implemented in research to examine the differences in perception across the measures and determine if one is more accurate and precise.

## Materials and Methods

### Study design and population

This study used a cross-sectional design to survey parents of 2 to 5-year-old children. Recruitment occurred at both standalone preschools and daycares with preschools with a total of 17 sites. Parents were defined as a person who is legally responsible for the child, whether there is a biological connection or not because this person performs everyday care for the child who is participating in the study [18].

For inclusion, participants needed to read and speak English and be a self-identified legal guardian for the participating child who was within the identified age group. If multiple siblings attended the daycare or preschool and were in the 2 to 5 age range, only one of the children could participate. Similarly, only one parent in a family could be included. People were excluded if a 2- to 5-year-old child already had a sibling involved in the study or if the child had a disease known to affect weight/size such as pituitary and thyroid conditions.

Once the parent filled out the survey and provided written consent for the child, the investigator assessed all weight and heights of participating children. Standing height and weight of the child was measured using an electronic digital body weight scale with a step on technology and a stable stadiometer, following World Health Organization guidelines [19]. Scale calibration was done at each site using a 2-pound weight to verify accuracy before weighing children. Children were asked to remove their shoes, jackets, and anything in their pockets, which is the conventional method [20]. They were asked not to wear extra layers of clothing, such as jackets to keep measurement consistent. Weight was also measured to the nearest 0.1 kilograms for accuracy as done by others [21,22].

Between either the daycare sending surveys home with parents and the investigator handing out surveys, 415 questionnaires were distributed. A total of 198 of 415 questionnaires were returned making the response rate 47.7%. This response rate is consistent with the projected less than a 50% return rate for surveys that are associated with unsolicited surveys with no face-to-face request [23]. Response rates where the investigator spoke with individuals and asked if they would participate had higher response rates ranging from 71.4% to 77%. Participant characteristics are displayed in Table 1.

### Variables

Data on Body Mass Index (BMI) were derived from investigator-assessed height and weight of each child and parent report of the child's age in months. The BMI for sex and age was calculated based on CDC standards, and the child was classified as obese, overweight, normal weight, or underweight [24].

Parental classification of their child's weight status was assessed using three different approaches: 1) parents were asked to classify their child into one of the four weight status categories using a four-point Likert scale (underweight, normal, overweight, obese), 2) parents used a pictorial scale showing children from various weight status to select the picture they considered to most accurately represent their child's physique, and 3) parents were asked to provide how much their child weighs in pounds. These questions allowed determination of weight discordance in all areas (visual, numerical, and categorical assessment of child weight). In each instance, a parental assessment was categorized as incorrect or correct based on the actual child weight and designated status. The weight report was based on Gordon and Mellor [11] that used actual weight + reported weight for the determination of correct. In other research using parent report of weight, parents have had to write the weight and fill out the survey on site while others have allowed parents to take home the survey and fill out this information. As the goal was to mirror other implementations and compare mechanisms, parents were allowed to take the survey home and return it.

### Statistical analysis

Data were analyzed using both Stata 14.1 (Stata Corporation, College Station, TX, US) and IBM SPSS Statistics 25. The CDC BMI Percentile Calculator for Child and Teens and Adult BMI Calculator [24] were used to determine BMI for adults and children as well as percentile rank for children.

Two-way tables of frequency compared parent classification (correct/incorrect) to the four categories of weight (underweight, healthy weight, overweight, and obese) for each classification type (pictorial, Likert, and written report of weight). Concordance between the measured and perceived weight status was assessed using the Kappa statistic. Rates of misclassification were also reported for each classification type and compared side-by-side. The association between types was analyzed using chi-square tests with phi coefficients and a point biserial correlation.

Sample size calculations were performed using G*Power: Statistical Power Analyses to determine the maximum needed samples to answer the questions. These sample size needs varied by analysis, though the minimum size was met for all calculations. For questions involving the point-biserial correlation, the needed sample size was 82. This number would detect a point-biserial correlation of 0.30 or higher at alpha = 0.05 (two-tailed) with minimum power = 0.80 and thus only require a minimum sample size of 82 participants.
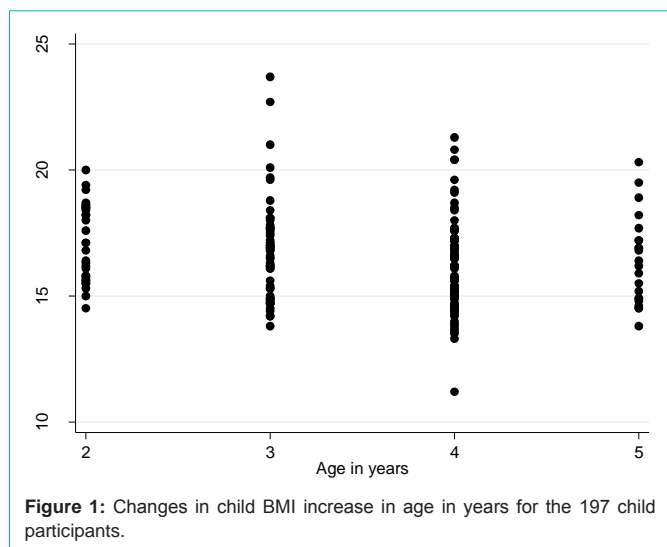
### Ethics statement

The Idaho State University IRB approved this study before it was conducted. All parents provided written consent for their child to participate. Weight for minor children was done in their classrooms with their teacher present, and a partition was used to ensure their privacy. All data were deidentified to protect privacy further.

## Results

Participants included 180 mothers, 22 fathers, and 2 grandparents. Even though two grandparents were included as they were primary caregivers, the caregivers are referred to using parental or parents for simplicity and understanding. Basic demographic features of the participants are listed in Table 1.

The average parental weight and height converted to an average

**Figure 1:** Changes in child BMI increase in age in years for the 197 child participants.

**Table 1:** Enrollment Statistics of Parents and Children.

| Category | No. (n=198) | % |
|---|---|---|
| | **Parents** | |
| **Sex** | | |
| Male | 22 | 11 |
| Female | 176 | 89 |
| **Age** | | |
| 18-20 | 2 | 1 |
| 21-29 | 72 | 37 |
| 30-39 | 104 | 53 |
| 40-49 | 17 | 8.6 |
| 50-59 | 2 | 1 |
| **Ethnicity** | | |
| White | 164 | 83 |
| Black | 6 | 3 |
| American Indian | 2 | 1 |
| Asian | 7 | 3.5 |
| Native Hawaiian | 1 | 0.5 |
| Hispanic | 12 | 6.1 |
| Multiple races | 6 | 3 |
| **Income** | | |
| 0-$9,999 | 7 | 3.6 |
| $10,000-$24,999 | 14 | 7.4 |
| $25,000-$49,999 | 37 | 19 |
| $50,000-$74,999 | 44 | 23 |
| $75,000-$99,999 | 52 | 27 |
| $100,000-$124,999 | 23 | 13 |
| $125,000-$149,000 | 8 | 4.2 |
| $150,000-$174,999 | 5 | 2.6 |
| $175,000 and up | 3 | 1.6 |
| **Education** | | |
| Less than high school | 4 | 2 |
| GED or high school | 41 | 21 |
| Some college or associates | 82 | 41 |
| Bachelor's degree | 54 | 27 |
| Graduate degree | 17 | 8.6 |
| | **Children** | |
| **Sex** | | |
| Male | 100 | 51 |
| Female | 98 | 50 |
| **Age** | | |
| 2 | 31 | 16 |
| 3 | 58 | 29 |
| 4 | 87 | 44 |
| 5 | 22 | 11 |

BMI of 27.20 (SD = 6.03), which is considered overweight by CDC guidelines. Meanwhile, the average child BMI percentile was 61.75 (SD =30.77), which indicates a healthy weight. Most children had a healthy weight (n = 118, 59.9%). The second highest number of children were classified as overweight (n = 47, 23.9%). Figure 1 shows how child BMI relates to age.

## Likert method

Parents were asked to classify their child's weight as very underweight, underweight, healthy weight, overweight, and obese. Most parents (n = 168, 84.9%) selected that their child was a healthy weight while only 10 (5.0%) described their child as overweight, 7 (3.5%) as very underweight, and 13 (6.5%) as underweight. The investigator combined the descriptions of very underweight and underweight into the underweight category to align parental reports with the four-point scale for analysis.

Overall, 53.3% (n = 105) of parents accurately described their child's weight by selecting the appropriate Likert-scale response while 46.7% (n = 92) were incorrect. As child sex had previously been described as related to classification in other research, the percent of correct classification was examined. Parents of boys were incorrect 54% (n = 54) and correct 46% (n = 46) with the Likert method. Meanwhile, parents of girls were incorrect 39.2% (n = 38) and correct 60.8% (n = 59). How child age affected classification with the Likert method was also examined. The highest percent of misclassification at 42.4% (n = 39) of 92 total incorrect and correct classification at 45.7% (n = 48) of 105 total correct was seen at age 4.

Table 2 shows how the Likert rating relates to overall classification status. No parent labeled their child as obese, despite 26 of 198 children (13.1%) having that designation based on sex, height, and weight.

## Weight-report method

Parents were asked to write what they thought their child weighed in pounds. Using the child's investigator-measured height (inches) and the reported weight, the child's' BMI and BMI percentile were determined. The mean BMI by parent report was 15.8 (SD = 2.8) with a percentile rank of 46.26 (SD = 34.71), which falls in the healthy range. Meanwhile, actual child BMI was 16.5 (SD = 1.8) with a percentile rank of 61.8 (SD = 30.8), which is also in the healthy range.

**Table 2:** Comparison of Parental Classification of 197 Children by Likert Description versus Actual Weight Category.

| Weight category | Incorrect classification | Correct classification |
|---|---|---|
| | (n = 92) | (n =105) |
| Underweight | 4 (4.3) | 2 (1.9) |
| Healthy weight | 16 (17.4) | 102 (97.1) |
| Overweight | 46 (50) | 1 (1) |
| Obese | 26 (28.3) | 0 (0) |

Note: Information is reported as number (%). One child was missing weight/height information.

**Table 3:** Comparison of Parental Classification Status of 183 Children Using Reported Weight in Pounds Versus Child's Actual Weight Category.

| Weight category | Incorrect classification | Correct classification |
|---|---|---|
| | (n = 91) | (n = 92) |
| Underweight | 27 (29.7) | 4 (4.4) |
| Healthy weight | 46 (50.5) | 65 (70.7) |
| Overweight | 9 (9.9) | 10 (10.9) |
| Obese | 9 (9.9) | 13 (14.1) |

Note. Information is reported as number (%). One child weight had a missing weight value.

**Table 4:** Comparison of Parental Classification Status of 197 Children by Pictorial Method versus Investigator-Assessed Weight Category.

| Weight category | Incorrect classification | Correct classification |
|---|---|---|
| | (n = 126) | (n = 71) |
| Underweight | 71 (35.9) | 11 (28.9) |
| Healthy weight | 118 (59.6) | 23 (60.5) |
| Overweight | 9 (4.6) | 3 (7.9) |
| Obese | 0 (0) | 0 (0) |

Note: Information is reported as number (%). One child weight had a missing weight value.

As reported earlier, 14 parents either did not know the weight (n = 10) or left it blank with no reason (n = 4). Therefore, for this portion of the analysis, the number was reduced (n = 184).

The accuracy of weight was determined as correct if the parent's written report of child weight was within two pounds of the child's actual weight. This criterion has been used by other researchers including Gordon and Mellor [11]. Using this method and the reduced sample (n = 184), the percent of correct classification was 50.3% (n = 92) and incorrect classification was 49.7% (n = 91).

Since the BMI healthy range spans across a large percentile range, this method of using within two-pounds does not capture if the parent sees their child as falling in a healthy-weight or other category. So, the parent reported weight was also used with the investigator-assessed height to determine where the child's BMI and percentile rank was with respect to the weight category. This information was used to classify the child as underweight, healthy weight, overweight, or obese according to the weight the parent reported. Results showed reported weight placed 16.9% (n = 31) as underweight, 60.7% (n = 111) as healthy weight, 10.4% (n = 19) as overweight, and 12.0% (n = 22) as obese.

As child sex had previously been described as related to classification, the percent of correct classification was examined for

**Table 5:** The Agreement between Parent's Descriptions of the Child's Perceived Weight Status and the Child's Actual Weight Status Based on CDC Guidelines at Age 2 to 5.

| Parental report of weight status | Child's actual weight status, n | | | |
|---|---|---|---|---|
| | Underweight | Healthy | Overweight | Obese |
| **Likert scale, (n=198)** | | | | |
| Underweight | 2 | 17 | 1 | 0 |
| Healthy | 4 | 98 | 45 | 21 |
| Overweight | 0 | 4 | 1 | 5 |
| Obese | 0 | 0 | 0 | 0 |
| **Weight in pounds, (n=183)** | | | | |
| Underweight | 2 | 24 | 4 | 1 |
| Healthy | 3 | 77 | 21 | 10 |
| Overweight | 0 | 4 | 9 | 6 |
| Obese | 1 | 2 | 10 | 9 |
| **Pictorial, (n=198)** | | | | |
| Underweight | 3 | 50 | 12 | 6 |
| Healthy | 3 | 64 | 31 | 19 |
| Overweight | 0 | 4 | 4 | 1 |
| Obese | 0 | 0 | 0 | 0 |

the weight-reporting method. Parents of boys were incorrect 47.9% (n = 46) and correct 52.1% (n = 50) with the weight-reporting method. Meanwhile, parents of girls were incorrect 51.7% (n = 45) and correct 48.3% (n = 42). How child age affected classification with the Likert method was also examined. The highest percent of misclassification at 43.9% (n = 40) of 91 total incorrect and correct classification at 42.4% (n = 39) of 92 total correct was seen at age 4.

Results of how overall parent-reported categories relate to CDC classification categories are seen in Table 3.

**Pictorial method**

The last method of classification was using a pictorial scale that showed children ranging from very underweight to obese. Parents could choose from a picture showing a very underweight child, an underweight child, a slightly underweight child, a healthy weight child, a slightly overweight child, or an obese child. Most parents choose one of the underweight images as representing their child as follows: 10.6% very underweight (n = 21), 25.3% underweight (n = 50), 32.3% as slightly underweight (n = 64), 27.8 as healthy weight (n = 54), and 4.6 as overweight (n = 4.6). However, only six children or 3.0% were underweight.

As child sex had previously been described as related to classification, the percent of correct classification was examined for the pictorial method as well. Parents of boys were incorrect 58.0% (n = 58) and correct 42% (n = 42) with the pictorial method. Meanwhile, parents of girls were incorrect 70.1% (n = 68) and correct 29.9% (n = 29). How child age affected classification with the Likert method was also examined. The highest percent of misclassification at 42.9% (n = 54) of 126 total incorrect and correct classification at 46.5% (n = 33) of 71 total correct was seen at age 4. Overall, parents were mostly inaccurate with the pictorial method as 64% (n = 126) were incorrect and 36.0% (n =71) were correct. The breakdown of classification

**Table 6:** Chi-Squared Test to Determine the Association between Parental Classification Ability among Child Weight Categories.

| Classification status | Actual child weight status | | | |
|---|---|---|---|---|
| | Underweight | Healthy | Overweight | Obese |
| **Pictorial** | | | | |
| Correct (n=71) | 3 | 64 | 4 | 0 |
| Incorrect (n=126) | 3 | 54 | 43 | 26 |
| **Likert** | | | | |
| Correct (n=105) | 2 | 102 | 1 | 0 |
| Incorrect (n=92) | 4 | 16 | 46 | 26 |
| **Weight** | | | | |
| Correct (n=92) | 3 | 61 | 19 | 9 |
| Incorrect (n=91) | 3 | 45 | 26 | 17 |

**Table 7:** Percent of Correct Versus Incorrect Classification by Assessment Method.

| Classification | Pictorial | Likert | Reported weight |
|---|---|---|---|
| Correct | 35.90% | 53.30% | 50.27% |
| Incorrect | 63.60% | 46.70% | 49.73% |

status by weight status using the pictorial scale is displayed in Table 4.

## Kappa analysis

Cohen's Kappa was used to determine the agreement between how parents perceived their child's weight using the three methods of classifications to the actual child weight status. Parents showed almost no agreement with either the pictorial method (κ = -0.028, p = 0.42) or the Likert method (κ = -0.032, p = 0.37). The result shows the agreement between the parental judgment of their child's weight was not significantly better than an agreement by chance alone with both the Likert and pictorial method. There was slight agreement with the parent report of weight in pounds and the actual child weight (κ = 0.21, p < 0.001). For this method, parents were more accurate at judging their child's weight and could do so significantly better than chance alone. Still, the degree of agreement beyond chance was only fair. Across the three methods, the accuracy of parents' assessments of child weight did not show substantial agreement with the investigator-assessed child weight categories. Parents had the most trouble with correctly classifying overweight and obese children, which is illustrated in Table 5.

Even though parents could not correctly identify their child's weight accurately, they were better at gauging their own weight. Parents were asked to self-report weight and height, which was used to determine their associated BMI score. They were also asked to identify their weight status on a Likert scale. There was a moderate agreement between their BMI and the Likert description they selected (κ = 0.43, p = 0.05).

## Chi-square analysis

The chi-square test of association was used to determine whether there was an association between whether parents were correct or incorrect in their assessment of their children compared to the child's actual weight for all three classification methods. The survey included 198 parents and their children. One child was not able to be weighed and 14 parents did not report an estimated weight for their child

with the weight-reporting method. The Cramer's was statistically significant for two of the three methods. Cramer's φ = 0.82 for the Likert method showed a large association (p < 0.001), while Cramer's φ = 0.49 for the pictorial method was a medium association (p < 0.001). The weight-reporting method and actual child weight did not have a significant association, Cramer's φ = 0.18 (p = 0.114), though it did show a small association.

The next evaluation was to use the chi-square test to determine how classification was associated with child sex. The chi-square test was statistically significant for the Likert classification method, $\chi^2$ (1, N = 197) = 3.74, p = 0.05, but not for the pictorial method, $\chi^2$ (1, N = 197) = 3.52, p = 0.08, or the weight-reporting method, $\chi^2$ (1, N = 183) = 0.44, p = 0.56. The test showed that of all parental misclassification, 58% in the Likert method, 49.5% in the weight-reporting method, and 45.2% in the pictorial method was of preschool boys. This study showed that boys were 1.82 times more likely than girls to have their weight misclassified using the Likert method (p = 0.04).

Across all three methods, parents were less able to identify children who were overweight and obese accurately. This was seen most drastically with the pictorial and Likert methods. Only 9% (n = 4) of parents could correctly identify their child as overweight using a pictorial scale and only 2% (n = 1) using a Likert scale. Parents were most accurate across all weight statuses when asked to report the child's weight in pounds. Using a weight reporting classification, 40% (n = 19) of parents accurately identified the weight of their child when classified as overweight. Table 6 displays these numbers and showcases how incorrect and correct classification related to actual child weight status in each classification type.

Parents had the most accuracy classifying child weight status by using the Likert scale at 53.3% and least accuracy with the ability to select the correct picture showing their child's weight at 35.9%. However, these overall statistics do not showcase the lower ability to categorize children who are either overweight or obese correctly. In the Likert method, the misclassification of overweight and obese youth accounts for 78.3% of the misclassification while it accounts for 54.8% in the pictorial method and 47.3% in the weight-reporting method. Description of overall parental accuracy by each method is compared side-by-side in Table 7.

## Point biserial correlation

A point biserial correlation between child weight and correct classification by Likert scale showed that as weight decreased parents' inaccuracy increased significantly, $r_{pb}$ = -0.18, 95% CI [0.04, -0.31], p = 0.011. A significant negative correlation was also found between parent-reported weight and actual child weight, r = -0.15, p = 0.037, showing that as child weight decreased parents' accuracy in reporting weight increased. No significant correlation was found between child weight and parental correct classification of child weight by the pictorial method, r = -0.08, p = 0.249.

The last component analyzed for this question were the relationships among the measures of classification. A chi-square test of association was used to determine whether there was an association between correct classification (0 = incorrect, 1 = correct) for each assessment method with correct classification based on the other assessment methods.

For comparison of the weight-reporting classification method versus pictorial classification method, the chi-square test was statistically significant, $\chi^2$ (1, N = 183) = 14.49, p < 0.001. The test showed that 78% (n = 71) of those who misreported weight in pounds also misreported weight via the pictorial method. Those who reported weight correctly in the pound classification method were evenly split when using the pictorial classification method with 51% (n = 47) being incorrect and 49% (n = 45) being correct. Cramer's $\varphi$ = 0.28 showed the association was medium sized.

Comparing the weight-reporting classification method and the Likert scale method also revealed a statistically significant chi-square test, $\chi^2$, (1, N = 183) = 7.48, p = 0.006. Of those who misreported weight with the weight-reporting method, 58.2% (n = 53) also misreported weight with the Likert method. The percentage of those who reported weight correctly with the weight-reporting method was split at 62% correct (n = 57) and 38% incorrect (n = 35) with the Likert method. Cramer's $\varphi$ = 0.20 showed the association was medium sized.

The chi-square test comparing the Likert classification method to the pictorial classification method was also statistically significant, $\chi^2$ (1, N = 197) = 43.43, p < 0.001. The test showed that 88% (n = 81) of those who incorrectly classified their child's weight using the Likert method also incorrectly classified weight by the pictorial method. Differences were seen with those who reported weight correctly with the Likert method as 42.9% (n = 45) were incorrect on the pictorial method, and 57.1% (n = 60) were correct. Cramer's $\varphi$ = 0.47 showed the association was large.

## Discussion

This was the first study identified that has compared all three types of commonly used methods to assess parental classification ability in children. One goal was to determine if one of these methods was most accurate regarding parental classification. Misclassification research has focused on using the Likert method where parents select a written description that most resembles their child, pictorial method where parents selected the image that most resembles their child and a method where parents report the child's weight in pounds. When looking at just the observed, overall percent of correct versus incorrect responses regarding child weight status, parents had the most accuracy with the Likert method at 53.3% and least accuracy of 35.9% with the ability to select the correct picture showing their child's weight. This dissertation's findings of inaccurate classification for each method - Likert at 46.7%, pictorial at 63.6%, and weight-reporting method at 49.7% - were higher than other results in the United States, including a 30% [25] and a 31% [26].

This study's Kappa findings also confirmed that accurate parental perception of child weight was poor, especially by the pictorial method and the Likert method. The low kappa values indicated that parental judgment of weight was not significantly improved over that of mere chance. Meanwhile, parents had a slight agreement between reported weight in pounds and the actual child weight category. Parental ability to classify by the weight-reporting method appeared better than the Likert or pictorial method, but this agreement may not accurately reflect parental ability to recognize abnormal weight patterns and may not accurately represent if parents had knowledge of the weight or if they weighed the child before answering. This is

discussed further below.

### Likert method

Having parent's select written descriptions of their child's weight is the most widely used method to classify parental perception of child weight status. It was recently used this method in New Zealand to understand how their parents viewed 1,093 children [27]. Using the Kappa method to test agreement, they found that parents of preschool children had fair agreement (κ = 0.35, 95% CI [0.32, 0.39]). Their result showed more agreement between parental perception and actual child weight, though it was still low. This study's findings show that the level of agreement between actual child weight and parental report of child weight was poor (κ = -.03) when using the Likert Method. These results indicated parents do not identify accurate child weight well using this method, and this was true especially in overweight and obese categories. In this study, 66 children who were overweight or obese were labeled as healthy weight by their parents. This accounted for 78.3% of the misclassification found in this study. This was consistent with other findings using the Likert method for classification that showed parents of overweight and obese children were highly inaccurate with classification [22,28,29].

### Pictorial method

Caregivers generally rated their own child as looking like the one in the middle of the scale [20]. Their results showed a modest correlation between the child's measured BMI percentile and the selected picture (r = 0.59). This dissertation study found that 27.2% (n = 54) of parents selected the middle child while more parents (35.9%, n = 71) favored the underweight end of the spectrum [20]. These parents selected an image of very underweight or underweight to represent their child. There was almost no agreement (κ = -0.03) between the actual child weight and the selected image [20].

### Weight method

Gordon and Mellor [11] used parent-reported weight as a means to gauge accuracy in child weight classification. They considered it correct if the response was within two pounds of the actual child weight. Their results showed that parent-reported weight was within two pounds of the child's actual weight for just under 60% of children. The Gordon and Mellor study had parents fill out a survey in a waiting room at the doctor's office. The parent's report of weight was compared to medical records of weight done on the same day as the survey. They found 22% of parents of 3- to 5-year-old children underestimated their child's weight by at least two pounds. This dissertation study showed that 36.2% (n = 72) underestimated child weight.

Gordon and Mellor [11] did not have a comparable measure for how reported weight compared to weight categories of underweight, healthy weight, overweight, or obese. Meanwhile, this study took the reported weights and actual height measurements to determine where the child would fall on the CDC percentile rankings. With this method of comparison, parents had a higher agreement with 50.3% describing accurate weight. The Kappa test also showed a slight agreement between actual child weight and parental report of child weight (κ = 0.21). Further, parents were asked to write how much the child weighed in pounds, but there was no instruction for parents not to weigh the child before answering or question that asked if they

had done so. This means this finding may not accurately reflect if parents knew the weight. Further, this finding showed that parents could indicate the correct weight, but it did not confirm if parents correctly recognized if the weight was healthy or not. This limitation of not understanding how parents view weight is consistent across studies that employed this method and thus pointed to questionable usefulness of this measure.

### Significance

The Likert method had the most accuracy regarding weight classification at 53.3%, but the report of weight method was second at 50.27%. Whether this difference was statistically significant was not evaluated. The pictorial method was last at 35.9% correct classifications. However, when looking at how much of the percent of misclassification was influenced by misclassifying overweight and obese children, the numbers changed. With the Likert method, 78.3% of the misclassifications were due to misclassification of overweight and obese preschoolers. Misclassification of overweight and obese preschoolers was 54.8% for the pictorial method, and 47.3% for the weight-reporting method. This finding showed that parents are likely to misclassify the weight of overweight and obese children. However, parents were least likely to do so when applying the weight-reporting method. Nevertheless, it was found that misclassifying the child weight in any of the three categories significantly increased the odds of misclassifying weight in the other two categories. The most significant association was seen between the Likert method and the pictorial method with a Cramer's $\varphi = 0.47$.

Both the pictorial method and the Likert method required parents to form a judgment about the size of their child. The pound-reporting method simply asked them to supply a number. So, while the parent had to describe the child visually as overweight or underweight with the pictorial method or select a comparably written description with the Likert method, the weight method just asked for a number. It was not determined if parents connected the number to a particular weight classification status, such as healthy weight or overweight, or if parents in this study provided a number after weighing the child themselves. It could be that the total percentage of parents who were accurate in reporting weight, were accurate only because they weighed their child after taking the survey home. The percentage of accurate classifications in this study when applying this method was higher than was found by Gordon and Mellor [11]. Gordon and Mellor performed a waiting room survey where parents filled out the questionnaire while waiting. In the present study, parents were allowed to take the survey home. Consequently, it is likely that some of the parents in this study weighed their child before answering the question.

This study's findings support the idea that parents are better able to correctly classify child weight when using either the Likert method or the child-weight reporting method than they were when using the pictorial method, and that parents were more accurate at identifying the child weight classification of overweight and obese children when using the child-weight reporting method. However, this finding might have been due to some parents having had knowledge of actual child weight, and it did not indicate whether they understood the child's weight status. The Likert and pictorial methods gave visual or descriptive clues to weight status, so they might be better methods

to gauge parental misclassifications. Nevertheless, in this study, the Likert method was slightly better in overall accuracy, but the parents were shown to classify child weight best for overweight and obese children when using the weight reporting method.

## Conclusions

Childhood obesity is an epidemic. While a multitude of factors places a child at risk for weight issues, parents are key influencers who have the potential to help or hinder this problem. It is clear that parents are not good at discriminating weight deviation in their children by any method. If parents cannot accurately understand weight, they may not be willing or even realize a need to make modifications in their home to help a child avoid lifelong weight struggles. Research is needed to further understand the disconnect between the parental perception of child weight and the reality of child weight. This is key to forming effective prevention and intervention efforts targeted for preschool children. This study adds data regarding parental perception of child weight status using all three commonly used methods.

## Funding

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