




## ORIGINAL ARTICLE

# Relationship between perceived and measured body size among Pacific 14-year-olds in Aotearoa|New Zealand: Findings from the Pacific Islands Families Study

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**Aim:** Pacific people carry a disproportionate burden of socio-cultural and economic determinants of health in Aotearoa | New Zealand (NZ), and 61.7% of Pacific children aged 0–14 years are overweight or obese. Yet Pacific children's self-perception of their body size is unknown. This population-based study aimed to investigate the concordance between measured and perceived body size in a cohort of Pacific 14-year-olds in NZ, and to assess how this relationship is influenced by their cultural orientation, socio-economic deprivation and degree of recreational internet use.

**Methods:** The Pacific Islands Families Study tracks a cohort of Pacific infants born in the year 2000 at Middlemore Hospital, South Auckland. This study is a nested cross-section of participants at the 14-year postpartum measurement wave. Following strict measurement protocols, body mass index was measured and categorised according to the World Health Organization classifications. Agreement and logistic regression analysis methods were employed.

**Results:** Of 834 participants with valid measures, 3 (0.4%) were measured as being underweight, 183 (21.9%) as normal, 235 (28.2%) as overweight and 413 (49.5%) as obese. Overall, 499 (59.8%) perceived their body size to have a lower classification than that when measured. Neither cultural orientation nor deprivation was significantly related to weight misconception but recreational internet use was, with higher use associated with increased misconception.

**Conclusions:** Improving body size awareness together with the risk of higher recreational internet use is likely to be an important component in any population-based healthy weight intervention formulation for Pacific adolescents.

**Key words:** adolescent; BMI; body size; epidemiology; Pacific health; perceived weight.

## What is already known on this topic

- 1 Pacific children and adolescents in Aotearoa|New Zealand have the highest prevalence of overweight and obesity relative to any other ethnic group.
- 2 Parental perceptions and concerns of their overweight or obese Pacific children were low.

## What this paper adds

- 1 Discordance between perceived and measured body size was common. Nearly three from every five Pacific 14-year-old participants underestimated their weight classification category.
- 2 Increased recreational internet use was associated with increased weight misconception.
- 3 Population-based healthy weight prevention and treatment interventions are likely to benefit from increasing body size awareness and communicating the risks associated with higher recreational internet use.

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Overweight and obesity impose a myriad of significant individual and societal health burdens for populations around the world. Globally, Aotearoa | New Zealand (NZ) has climbed to the second-most overweight country in the Organisation for Economic Co-operation and Development (OECD).<sup>1</sup> Approximately one in three NZ children are now classified as being overweight or obese.<sup>2</sup> Moreover, childhood overweight and obesity is the strongest predictor of adult obesity, and early prevention is key.<sup>3</sup>

This issue is so pervasive in NZ that the National Science Challenge – a cross-disciplinary mission-led programme designed to tackle the nation's biggest science-based challenges – has a primary aim of developing better methods and tools for prediction, prevention, and treatment of overweight and obesity in children.

NZ has an ethnically diverse population, including 8.1% who identify as Pacific at the 2018 Census. However, Pacific people in NZ carry a disproportionate burden of socio-cultural and economic determinants of poor health.<sup>4</sup> This burden likely explains the 61.7% of Pacific children aged 0–14 years classified as overweight or obese in the 2020/2021 NZ Health Survey.<sup>2</sup> These Pacific rates are substantially higher than all other reported ethnic groups in NZ, with the dominant European/Other group having an estimated prevalence of 26.5%.

In addition to the unequally shared socio-cultural, economic and obesogenic environmental contexts within NZ,<sup>4</sup> body size perception is one of many psycho-cultural factors that contributes to obesity. Having positive perceptions towards larger body sizes significantly contributes to greater obesity prevalence in many populations, including Pacific.<sup>5</sup> Thus culturally positive perceptions of body weight may also influence the relationship between perceived body weight and measured body weight. Parents of overweight and obese Pacific children in NZ have previously shown relatively lower levels of concern regarding their children's weight status.<sup>6</sup> Weight misperception is also associated with reduced interest and attempts at losing weight in overweight and obese adults.<sup>7</sup> If there is a significant discordance between perception and reality then population-based health promotions or interventions are likely to be relatively ineffective, especially if they are not culturally embedded.<sup>8</sup> However, this relationship between perceived and measured body weight in Pacific adolescents is currently unknown despite their relatively high overweight and obese rates.

In today's world, social media and the internet are now ubiquitous sources of information that can provide both positive and negative information regarding public health issues.<sup>9</sup> Stigmatisation, negative stereotypes and ridicule in the form of humour towards overweight and obese people in common on many digital platforms. Such platforms can also be a source of social support for weight loss with, for example, 'fat acceptance' messaging gaining popularity.<sup>10</sup> Online gaming, particularly massively multiplayer online role playing games, offers an escape from the 'real world' and may affect willingness to invest time and energy in improving quality of life.<sup>11</sup> Higher rates of video gaming have also shown some positive association with higher body mass.<sup>12</sup> Despite this being known, we could find no studies exploring the impact of recreational internet use on young people's perception of their body size in relation to objectively measured size.

Utilising a NZ birth cohort of Pacific adolescents, this study investigates the concordance between measured body weight and their perceived body size. Recognising the potential influences of cultural orientation, socio-economic deprivation and internet use on these concordance rates, their potentially confounding effects are also explored.

## Methods

### Study design

The Pacific Islands Families (PIF) Study tracks a cohort of Pacific infants born in the year 2000 at Middlemore Hospital, South

Auckland. This is a nested cross-sectional study of participants at the 14-year postpartum measurement wave.

### Participants

All potential participants in the PIF Study were selected from births where at least one parent was identified as being of a Pacific ethnicity and a NZ permanent resident. Recruitment was made through the Hospital's Birthing Unit, and consent was sought to make a home visit. The current analysis utilises data from singleton and first-born (from multiple live births) participants who were assessed at the 14-year measurement wave.

### Procedure

Approximately 6-weeks postpartum, potential maternal participants were visited at home by female Pacific interviewers fluent in both English and Pacific language(s). Once eligibility was confirmed and written informed consent obtained, mothers participated in a series of interviews. At the 14-year measurement wave, conducted from May 2014 to July 2015, adolescent assessments were undertaken. This assessment was normally conducted at the young person's school and only after receiving caregiver consent and written informed child assent. Detailed information about the cohort, utilised instruments and procedures is described elsewhere.<sup>13</sup>

### Primary measures

Following strict measurement protocols,<sup>13</sup> body mass index (BMI) was derived from weight and height ( $\text{kg}/\text{m}^2$ ), and categorised according to the World Health Organization BMI growth reference classification standardised for age (in months) and sex.<sup>14</sup> Underweight was defined as having a z-score  $< -2$ ; normal as having  $-2 \leq \text{z-score} \leq 1$ ; overweight as having  $1 < \text{z-score} \leq 2$ ; and, obese as z-score  $> 2$ . Weight self-perception was taken from the Youth Connectedness Survey.<sup>15</sup> Participants were asked 'thinking about your weight, would you say you are:' and given the response options 'underweight', 'a little underweight', 'about right', 'a little overweight', or 'overweight'. After variable description, to align these disparate measured and perceived classifications for concordance analysis, contiguous categories were collapsed with: BMI categories overweight and obese combined and labelled 'overweight/obese'; perception categories of underweight and a little underweight combined into 'underweight'; and, perception categories of a little overweight and overweight combined into 'overweight'.

### Socio-demographic and potentially confounding variables

Socio-demographic variables included age, sex (female or male) and ethnic identification. Age was calculated by subtracting the assessment date from participant's birth date. Self-identified ethnicity was classified into Sāmoan, Tongan, Cook Islands Māori, Niuean and 'Other Pacific' groups. Participants who identified equally with two or more Pacific ethnicities were included within the Other group. Internet use questions were informed by the Youth Connectedness Survey.<sup>15</sup> Two questions were asked, one

about recreational internet use, and the second eliciting the hours/day used in their spare time (see Supporting Information). Pubertal development was measured using the Pubertal Development Scale (PDS), a self-report measure indicating changes in physical appearance and reproductive physiology.<sup>16</sup> PDS scores range from 0 to 4, with 0 indicating no development and 4 indicating completion of pubertal development. Cultural orientation and socio-economic deprivation were elicited from participants' primary caregivers at the 14-year measurement wave and used as proxy measures. Assessed using a bi-directional acculturation framework instrument, with scores partitioned by median-splits, cultural orientation was assigned as: integrator (higher Pacific/higher NZ); separator (higher Pacific/lower NZ); assimilator (lower Pacific/higher NZ); or marginalist (lower Pacific/lower NZ).<sup>17</sup> Socio-economic deprivation was measured using the eight question NZiDep instrument, which yields five ordinal categories ranging from no deprivation to 5+ deprivation characteristics.<sup>18</sup>

### Statistical analysis

Reporting of analyses was informed by the STROBE guidelines ([www.strobe-statement.org](http://www.strobe-statement.org)). All analyses were performed using Stata SE version 17.0 (StataCorp, College Station, TX, USA), and two-sided  $\alpha = 0.05$  defined significance. Participant recruitment and retention numbers were initially reported, followed by baseline descriptive characteristics of participants. Agreement between perceived and measured body size categories beyond random variation was analysed using Cohen's weighted  $\kappa$  while asymmetry was investigated using an extension to McNemar's test. Unadjusted and adjusted logistic regression models were employed to estimate the effects of cultural orientation, socio-economic deprivation and the degree of recreational internet use on the likelihood of perception discrepancy. Ward's type III  $\chi^2$  tests were used to ascertain variable significance in these regression models. Area under the receiver operating characteristic curve (AUC) was used to assess the adjusted model's predictive ability, with 0.7–0.8 considered acceptable, 0.8–0.9 excellent and >0.9 outstanding.

### Ethics

Ethical clearance was obtained from the Southern Health and Disability Ethics Committee (13/STH/159).

## Results

### Participants

The PIF study recruited 1376 mothers and 1398 Pacific infants at baseline. At the 14-year measurement wave, 931 adolescents participated. Of these, 15 were second-born thus excluded, leaving an eligible sample of 916 Pacific adolescents.

### Socio-demographics

The mean participant age was 14.3 years (range: 13.4–15.3 years), and 452 (49.3%) were female. Table 1 includes their socio-demographic characteristics. Multiple ethnic identifications were common, with 257 (28.4%) participants identifying with two, 65 (7.2%) with three, 10 (1.1%) with four and 2 (0.2%) with five

**Table 1** Socio-demographic characteristics of participating Pacific adolescents at the 14-year measurement wave ( $n = 916$ )

	<i>n</i> (%)
Gender	
Female	452 (49.3)
Male	464 (50.7)
Primary ethnic identification	
Sāmoan	414 (45.2)
Tongan	218 (23.8)
Cook Islands Māori	121 (13.2)
Niuean	32 (3.5)
Other†	131 (14.3)
Cultural orientation‡	
Integrator (higher Pacific/higher NZ)	94 (11.0)
Separator (higher Pacific/lower NZ)	243 (28.6)
Assimilator (lower Pacific/higher NZ)	357 (42.0)
Marginalist (lower Pacific/lower NZ)	157 (18.4)
Socio-economic deprivation	
No deprivation characteristics	107 (11.7)
1 deprivation characteristic	169 (18.4)
2 deprivation characteristics	203 (22.2)
3–4 deprivation characteristics	278 (30.3)
5+ deprivation characteristics	159 (17.4)

† Includes those self-identifying equally with two or more ethnicities.  
‡ Derived from the primary caregivers 14-years postpartum interview with data missing for 65 (7.1%).

ethnicities. However, Sāmoan (45.2%), Tongan (23.8%) and Cook Island Māori (13.2%) were the primary ethnic identification for participants; see Table 1. Using primary caregivers responses as proxy, assimilators (with higher orientation to NZ culture and lower Pacific cultural orientation) were most common among participants, followed by separators (with higher orientation to Pacific culture and lower NZ cultural orientation). Socio-economic deprivation was common with only 11.7% recording no deprivation characteristics.

### Measured and perceived body size

Overall, 834 (91.0%) participants had valid BMI and weight-perception values. Their mean measured BMI was 27.9 kg/m<sup>2</sup> (range: 15.4–55.8 kg/m<sup>2</sup>). Applying the BMI classifications, 3 (0.4%) participants were categorised as being underweight, 183 (21.9%) as normal, 235 (28.2%) as overweight and 413 (49.5%) as obese. In terms of their perceptions, 20 (2.4%) perceived themselves as underweight, 106 (12.7%) a little underweight, 447 (43.6%) as about right, 217 (26.0%) as a little overweight and 44 (5.3%) perceived themselves as being overweight.

Table 2 presents the joint distribution of these measured and perceived body size classifications, after contiguous category collapsing for alignment. Analysis of these measured and perceived body size variables reveals no agreement (weighted  $\kappa = -0.12$ , 95% CI:  $-0.15, -0.08$ ) and significant asymmetry ( $P < 0.001$ ), with measured body size more likely to be higher than perceived size than *vice versa*. Overall, 499 (59.8%) participants perceived their body size to be one or more categories lower than their

**Table 2** Frequency distribution of perceived weight against measured BMI categories for participants with valid measurements ( $n = 834$ ; 91.0%)

Perception†	Measured BMI categories		
	Underweight <i>n</i> (%)	Normal <i>n</i> (%)	Overweight/Obese <i>n</i> (%)
Underweight	0 (0.0)	17 (1.9)	109 (11.9)
Normal	2 (0.2)	72 (7.9)	373 (40.7)
Overweight	1 (0.1)	94 (10.3)	166 (18.1)

† Underweight perception combines underweight and a little underweight groups; normal perception is the about right group; and overweight perception combines a little overweight and overweight groups.

measured body size, while 238 (28.5%) participants had perceptions which were concordant with what was measured. Conversely, 97 (11.6%) of participants perceived their body size to be one or more categories higher than their measured body size, with 94 of these perceiving that they were overweight when their BMI classification was normal.

### The effect of cultural orientation, socio-economic deprivation and recreational internet use

Here a subsample was utilised, namely: those with concordant perception and measured body size classifications ( $n = 238$ , the concordant group); and, those whose perception was less than

their measured body size classifications ( $n = 499$ , the discordant group). Table 3 displays results from unadjusted and adjusted logistic regression model analyses. No difference was found between these groups and cultural orientation or socio-economic deprivation in either unadjusted ( $P = 0.31$  and  $P = 0.92$ ) or adjusted ( $P = 0.50$  and  $P = 0.95$ ) analyses, respectively. However, for this subsample, 463 (67.5%) participants reported recreational internet use of 1+ h/day with 84 (12.2%) reporting 6+ h/day. Increased reported recreational internet use was associated with increasing odds of body size discordance in both crude ( $P = 0.006$ ) and adjusted analyses ( $P = 0.006$ ). Participants who used the internet 6+ h/day had an estimated adjusted odds of body size discordance 2.73 (95% CI: 1.42, 5.26) higher than those who recreationally used the internet <1 h/day; see Table 3. The adjusted model's AUC = 0.63 (95% CI: 0.58, 0.68).

### Discussion

Weight misperception was common among Pacific 14-year-olds in NZ. Nearly three from every five ( $n = 499$ ; 59.8%) Pacific adolescent participants in this study reported their perceived body size categorisation as being less than that objective measured. These results are consistent with parent's misperceptions reported in an earlier PIF study.<sup>6</sup> The large asymmetrical discordance identified here, together with these previous parental findings, suggested that population-based healthy weight promotion messages are likely to lack perceived applicability or resonance among Pacific people in NZ. Moreover, behaviour change approaches to health promotion through self-regulation are a commonly employed approach targeting unhealthy behaviours.<sup>19</sup> Applying this Western-centric approach is less effective in non-Western cultural contexts,<sup>20</sup> and likely to have limited success in

**Table 3** Frequencies and odds ratios (ORs), together with associated 95% confidence intervals (CIs), of concordant perceived and measured body size group ( $n = 238$ ; 28.5%) and lower-perceived, higher-measured discordant group ( $n = 499$ ; 67.7%) responses partitioned by cultural orientation, socio-economic deprivation and recreational internet use

	Concordant group <i>n</i> (%)	Discordant values <i>n</i> (%)	Logistic regression	
			Unadjusted OR (95% CI)	Adjusted† OR (95% CI)
<b>Cultural orientation</b>				
Integrator (higher Pacific/higher NZ)	27 (35.1)	50 (64.9)	1.06 (0.63, 1.80)	1.12 (0.62, 2.02)
Separator (higher Pacific/lower NZ)	57 (28.4)	144 (71.6)	1.45 (0.98, 2.14)	1.41 (0.88, 2.25)
Assimilator (lower Pacific/higher NZ)	102 (36.4)	178 (63.6)	1 (reference)	1 (reference)
Marginalist (lower Pacific/lower NZ)	41 (32.0)	87 (68.0)	1.22 (0.78, 1.90)	1.32 (0.80, 2.18)
<b>Socio-economic deprivation</b>				
No deprivation characteristics	27 (32.9)	55 (67.1)	1 (reference)	1 (reference)
1 deprivation characteristic	42 (29.0)	103 (71.0)	1.20 (0.67, 2.16)	1.08 (0.56, 2.09)
2 deprivation characteristics	52 (32.9)	106 (67.1)	1.00 (0.57, 1.77)	0.89 (0.47, 1.66)
3–4 deprivation characteristics	73 (32.9)	149 (67.1)	1.00 (0.58, 1.72)	0.89 (0.49, 1.63)
5+ deprivation characteristics	44 (33.8)	86 (66.2)	0.96 (0.53, 1.73)	0.93 (0.48, 1.81)
<b>Recreational internet use (h/day)</b>				
<1	91 (40.8)	132 (59.2)	1 (reference)	1 (reference)
1–2	54 (33.5)	107 (66.5)	1.37 (0.90, 2.08)	1.29 (0.82, 2.03)
2–6	61 (28.0)	157 (72.0)	1.77 (1.19, 2.64)	1.80 (1.17, 2.78)
6+	19 (22.6)	65 (77.4)	2.36 (1.32, 4.20)	2.73 (1.42, 5.26)

† Adjusted for sex, age, ethnicity, pubertal development, cultural orientation, socio-economic deprivation and recreational internet use ( $n = 619$ ).

reducing Pacific adolescents overweight and obesity burden when self-perception is so low.<sup>4</sup> A co-designed supportive and empowering culturally nuanced approach which ameliorates the social determinants of health inequities for Pacific people is likely to yield more success.<sup>21,22</sup>

Interestingly, a significant dose–response association was found between recreational internet use and discordant weight perception. Existing literature on the role internet use plays in relation to overweight and obesity is multi-faceted, as internet use has many forms and many possible modes of influence on body weight and self-perception,<sup>9</sup> such as body positivity that promotes body size acceptance, and fat shaming which can increase negative feelings towards one's body size.<sup>10</sup> The specific biological mechanism requires further investigation. Studies have shown that watching videos on topics such as Thinspiration and Mukbang on platforms like YouTube and TikTok may influence disordered eating habits such as food restriction or overeating.<sup>23,24</sup> Perhaps the escape from reality offered by massively multiplayer online role playing games or video gaming may also ultimately distort some body size realities?<sup>11,12</sup>

Of note, this study found no difference in Pacific 14-year-olds' weight misperception between cultural orientation and socio-economic deprivation groups. This suggests that it is being Pacific, rather than particular alignment with heritage or NZ culture, leads to this weight misperception. And while patterns of overweight and obesity in Pacific people within NZ are likely predominantly, if not entirely, due to social determinants of health inequities rather than intrinsic cultural differences,<sup>4</sup> weight misperception is equally ubiquitous across Pacific groups. A similar rationale likely explains the lack of socio-economic deprivation differences between groups. While there is an increasing overweight and obesity rate gradient with increasing deprivation,<sup>2</sup> this does not translate to changes in weight misperception.

Previous research in general adolescent populations has shown that body weight perceptions tend to be inaccurate when compared with measured BMI categorisations.<sup>25</sup> Although, small sample sizes and a lack of racial and ethnic diversity have limited the external validity of some of these findings.<sup>25</sup> In studies reporting ethnic diverse adolescent populations, there is also considerable variability in estimates. For instance, in a multi-ethnic sample of 2789 early adolescents from three highly deprived regional authorities in East London, only 20% of overweight boys and 51% of overweight girls assessed their weight accurately; and, notably, weight perception accuracy did not vary between ethnic groups.<sup>26</sup> However, in a US study of 66 235 adolescents, 31% of overweight participants misperceived their weight, and significant ethnic differences were found – with overweight African American adolescents more likely to have weight misperceptions (45.2%) than overweight Hispanic adolescents (34.7%) who, in turn, were more likely to have weight misperceptions than their overweight white counterparts (28.2%).<sup>27</sup> While in a study of 737 European, Melanesian and Polynesian adolescents from New Caledonia, 53% of boys and 48% of girls who were overweight or obese underestimated their weight status, and no significant ethnic differences were found between these underestimations.<sup>28</sup> No comparable data appears to exist for ethnically diverse NZ adolescents. Weight misperceptions for ethnically diverse adolescent populations likely hinge on a number of contextual influences, including geo-political,

economic, environmental and social determinants of health factors together with their immigration histories.

The study has a number of salient strengths and limitations. A primary strength is the rigorous assessment of body size in a large prospectively collected representative sample of Pacific adolescents in NZ.<sup>13</sup> Moreover, it also brings together apposite variables, such as cultural orientation, not explored before on a population level. However, there are also a number of important weaknesses. Arguably, the study's greatest weakness is the difference between defined BMI and elicited weight perception categories. This required contiguous category collapsing and the perception of obesity could not be explored. Ideally, a direct match between elicited and measured body weight categories would have been captured. BMI itself as a measure also has some limitations, as it is a useful tool for determining healthy body weight on a population level, but does not account for important factors including muscle mass and bone structure on an individual level.<sup>29</sup> Additionally, some significant changes in adolescent social media and internet use have occurred since the collection of this data, particularly in the post-COVID-19 era, therefore these findings may no longer fully reflect current Pacific Island adolescent internet use in NZ.

## Conclusions

While overweight and obesity rates are relatively high, the misperception of Pacific 14-year-olds' body size is common. Conventional population-based health weight promotion interventions are thus likely to remain ineffective. In Pacific communities, weight reduction interventions need to recognise and be responsive to the cultural beliefs of the individual and their family regarding health and body size. Redressing systemic socio-cultural and economic inequalities will likely have the greatest impact. Additionally, digital platforms have significant and arguable increasing influence on adolescents and their perceptions. In developing strategies to tackle the issue of overweight and obesity, it is important to meet these young people where they are and in ways which appeal to them. A social media-based strategy applying techniques and lessons learned from other social media-based weight interventions may be an avenue worthy of consideration.

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## Data Availability Statement

The datasets used for statistical analysis are held by the PIF study directorate (see: <https://phrc.aut.ac.nz/our-research/pacific-islands-families-study>). Application to use these data must be made through this directorate.

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## Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

**Data S1** Supporting Information.