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1 **ABSTRACT:**

2 **Objective:** To describe the prevalence, and socio-demographic characteristics associated with
3 body mass index among children attending childcare services in New South Wales (NSW),
4 Australia. **Method:** Cross-sectional study of parent-reported socio-demographic characteristics
5 and objectively measured height and weight among children aged 2-5 years attending 40
6 randomly selected long day care centres and preschools. **Results:** Seven hundred and sixty four
7 children, 11% of whom were Indigenous, participated in the study (response rate = 66%). Overall,
8 16.7% of children and 24.6% of Indigenous children were overweight or obese. Overweight and
9 obesity was higher among children whose mothers did not have a university education (OR 1.91:
10 95%CI 1.15, 3.12) and who were Indigenous (OR 1.74: 95%CI 1.05, 2.90). No differences in
11 prevalence were found between geographic areas. Multivariate analysis indicated that after
12 adjusting for age, childcare service hours and other demographic covariates, only maternal
13 education remained a significant predictor of weight status (OR 2.06 95%CI: 1.16, 3.66).
14 **Conclusion:** The high prevalence of overweight and obesity among children attending childcare
15 services underscores the importance of obesity prevention interventions in early childcare
16 settings, and particularly those catering for Indigenous children.

17 *Key words: Obesity, Child, Indigenous, Childcare Preschool, Socio-economic, Rural*

18

1 INTRODUCTION

2 Epidemiological research has identified child overweight and obesity as an increasingly salient
3 global public health issue.^{1,2} Given the importance of the early childhood years on the
4 establishment of healthy eating and physical activity behaviours³ and the increasing number of
5 children in childcare in Australia,⁴ the implementation of public health interventions in child care
6 services has been recommended as a key strategy in the prevention of overweight and obesity in
7 this country.⁵

8
9 Guidelines for the development of ‘settings-based’ public health interventions highlight the
10 importance of obtaining settings-based epidemiological data to guide intervention planning and
11 implementation⁶. Such data can define the potential reach of interventions in a particular setting
12 and provide information regarding the socio-demographic or ‘setting’ factors upon which to tailor
13 intervention design and content.⁶ As such, epidemiological data regarding the prevalence, and
14 socioeconomic and geographic distribution of overweight and obesity among children in
15 childcare is required to facilitate the development of effective public health interventions
16 targeting child weight in this setting.

17
18 Quantifying the prevalence of obesity among children attending childcare from non-metropolitan
19 areas may be particularly important as a lack of access to obesity prevention resources and
20 professional development opportunities for childcare service staff⁷ and the greater financial
21 constraints often experienced by smaller rural childcare services⁸ may limit their capacity to
22 encourage physical activity and healthy eating among children in their care. Although a number
23 of community-based studies have examined the weight status of children less than 5 years of age
24 in Australia⁹⁻¹³, a review of the literature by the authors located just one study that recruited
25 children from child care services in rural and regional areas, The study was conducted in 2003/4
26 and described the prevalence of overweight and obesity of children aged 2-12 years attending pre-

1 schools and schools in the Barwon South-Western region of Victoria.¹⁰ While preschool children
2 were included in the study, aggregated obesity prevalence rates were reported for children in the
3 2-5.9 year age band, an age band which would have also included the weight status of children at
4 primary school. Twenty four percent of the 201 participating boys and 30% of the 225
5 participating girls in this age range were overweight or obese.¹⁰ The study also investigated
6 socio-demographic associations with child weight status, however, these analyses were reported
7 as aggregated data for the entire sample of children 2-12 years.

8
9 The prevalence of overweight and obesity reported in this single regional study appeared similar
10 to the only other published assessment of weight status of children attending childcare.¹² The
11 latter study was conducted in 12 randomly selected preschools in Melbourne and four early
12 childhood centre's in Sydney¹² between 1996-1998. Melbourne and Sydney are large
13 metropolitan Australian cities. The study found that 22% and 24% of boys and 26% and 34% of
14 girls from Melbourne and Sydney respectively were overweight or obese.¹² Apart from gender,
15 the study did not investigate the potential that child weight may be associated with any other
16 factors.

17
18 Given the lack of recent epidemiological data describing the weight status of children in
19 childcare, particularly in rural and regional areas, the aim of this study was to describe the
20 prevalence, and socio-demographic characteristics associated with child weight status among
21 children attending rural and regional childcare services in New South Wales (NSW), Australia.

22 23 **METHOD**

24 25 **Design and Sample:**

1 The study was conducted as part of baseline data collection for *Good for Kids. Good for Life.* a
2 community wide child obesity prevention program¹⁴ A cross-sectional survey of children aged 2-
3 5 years attending preschool and long day care centres in the Hunter New England region of NSW,
4 Australia was conducted between February and May 2007. The region covers an area of 130,000
5 square kilometers with a population of 837,000 and encompasses regional cities, rural and remote
6 towns.¹⁵ The study was approved by the Hunter New England Human Research Ethics
7 Committee.

8
9 The sampling frame comprised of a list of all licensed childcare services for the region which was
10 supplied by the NSW Department of Community Services (the licensing authority). Preschools
11 and long day care centres were excluded if they had less than 20 licensed places for children over
12 2 years or were services providing specialist care for children. A random quota sample of 40
13 services stratified by remoteness according to the Australian Standard Geographical
14 Classification,¹⁶ and service type (preschool or long day care) was drawn from the list of eligible
15 services. The sampling frame and selection process was conducted to maximize the likelihood
16 that the study findings would be representative of children attending childcare in the study region.

17
18 Authorised supervisors of randomly selected childcare services were mailed a study information
19 sheet and consent form seeking permission to conduct the study in their service. Authorised
20 supervisors interested in participating in the study were contacted by the research team to arrange
21 a date for the collection of data. Study information packs, consent forms and parent
22 questionnaires were distributed to parents of children attending the childcare services on a day of
23 the week selected by the authorised supervisor for data-collection. Distribution of study materials
24 to parents occurred via means considered most appropriate by authorised supervisors, (e.g.,
25 handed directly to parents or placed in children's pigeon hole). Two weeks later, a reminder letter

was similarly distributed to parents. On the day of data collection, children with signed parental consent were invited to participate in the study.

Data Collection and Measures

Data were collected between February and May 2007 by four groups of four field officers who were trained in data collection procedures and protocols prior to the study. Field officers were required to reach 99% inter-observer agreement criterion for all anthropometric measures before the commencement of the data collection.

Socio-demographic characteristics

Parents of participating children were invited to complete a pen and paper questionnaire at the time of providing consent and to return these documents in a sealed envelop to the childcare service. Demographic information including parent's reporting their child's Indigenous status, sex, date of birth, and paternal and maternal education, household income, time children spent in childcare and residential postcode. Postcode of residence was used to determine locality as either urban or rural ¹⁷

Weight status

Standard procedures were used to assess anthropometry.¹⁸ Height was assessed using portable stadiometers and the stretch stature method and were taken to the nearest 0.1cm and Tanita HD646 bathroom scales were used to assess weight to the nearest 0.1kg. Measurements of children were taken in light clothing with jackets and shoes removed and pockets empty of heavy objects. Height and weight measures were used to calculate body mass index (BMI; kg/m²) and BMI categorized using international guidelines for underweight, not overweight or obese, overweight, or obese.¹⁹

Data analysis

Data were analysed using SPSS Complex Samples (version 17) to account for the clustering design of the study and adjusted for the standard errors. Demographic covariates included locality (urban or rural), quartiles of household income (<\$40,000, ≥\$40,000-\$99,999 or ≥\$100,000); Indigenous status (Indigenous or Non-Indigenous); and because 88% of parent respondents were mothers, maternal education was used as a covariate and categorized as high school/diploma or university degree. Potential bias arising from missing data (Indigenous status (n = 22) maternal education (n = 80); household income (n = 123)) were checked to determine that the values were missing on a random basis and to ensure that the estimates were unbiased.

Prevalence and 95% confidence intervals (95%CI) were calculated for all demographic variables by BMI category (underweight, overweight, obese and overweight and obese combined). Bi-variable analyses using cross-tabulations with χ^2 tests were performed to examine the differences between not overweight/obese and overweight/obese and demographic characteristics, and unadjusted odds ratios (ORs) and corresponding 95%CI calculated. Multivariable logistic regression models adjusting for all covariates (sex, Indigenous status, household income, maternal education, age and time spent in childcare services (hours/week) were constructed to examine the differences between not overweight/obese and overweight and obesity combined to calculate adjusted odds ratios and corresponding 95% confidence intervals..

RESULTS:

Sample

Childcare services

Sixty eight childcare services were approached to participate in the study to yield the final targeted sample of 40 participating services (response rate = 59%). There were no significant differences between services that did and did not participate in the study in the number of

licensed places (39 places v.s 41places $p = .50$), or hours of operation (8.9 hours vs 8.4 hours $p = .41$).

Children

Anthropometric data was collected from 764 children enrolled to attend children's service on the day of field data collection (66% response rate) and 718 (94%) of these children's parents completed and returned the questionnaire. The mean age of children was 3.89 years (SD 0.79), 50% were boys, 36% were from a household with a university educated parent and 11% of children were Aboriginal or Torres Strait Islander. The mean time spent in childcare services was 17.4 hrs (SD 9.6) per week. Based on analysis of NSW Health survey data, a continuous random household survey utilizing a random digit dial technique, within NSW and the study region respectively, 39% and 29% of children 3-5 years in are from a household with a tertiary educated mother.²⁰

Insert Table 1 about here

Prevalence and association with socio-demographic characteristics

Overweight and Obesity

The prevalence of preschoolers' weight status by demographic characteristics are presented in Table 1. Overall, 9.3% were underweight and 16.7% of preschool aged children were overweight or obese combined. The likelihood of a child attending formal childcare being overweight or obese was significantly higher among children whose mothers did not have a university education (OR 1.91: 95%CI 1.15, 3.12) and who were Indigenous (OR 1.74: 95%CI 1.05, 2.90). Multiple logistic regression models showed that after adjusting for age, childcare service hours and other demographic covariates, only maternal education remained a significant predictor of overweight and obesity among children attending childcare (OR 2.06 95%CI: 1.16, 3.66)

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DISCUSSION

This study provides an important update on the prevalence of overweight and obesity among preschool aged children, including Indigenous children in childcare services in regional NSW, Australia, at a time when Australian governments are developing health policy and programs to address the burden of obesity.²¹ The study found that approximately 17% of all children and 25% of Indigenous children attending rural and regional childcare services in the study area were overweight or obese. While lower than previous estimates of child overweight and obesity among children of this age, such prevalence rates remain unacceptably high and confirm the need prevention interventions targeting obesity in this setting.

For boys, the prevalence of overweight and obesity reported in this study (15.6%) was lower than previous estimates of children from childcare services (22 -24%)^{10,12} and community samples of children aged five years and under generally (16-19%).^{9,11,13} Similarly, for girls, the prevalence of overweight and obesity found in this study (17.8%) was lower than has been reported in studies of children in childcare (26% -34%)^{10,12} as well as other population based research of children of this age (21-23%).^{9,11,13} The prevalence of preschool aged children in this study who were underweight (9%) was almost twice that of the national prevalence (4-5%) for children of this age.⁹ A number of factors may have contributed to the unexpectedly low rates of overweight and obesity in the study compared with previous studies. For example, an increase in negative obesity media coverage in recent years, particularly that which infers individual and parental responsibility for child weight may have increased the likelihood of study non participation among children who were overweight or obese^{22,23} Furthermore, compared to previous studies, mothers of child participants of this study were more likely to be university educated, a factor found in this study to be negatively associated with child overweight and obesity.^{10,13}

1 An alternate interpretation of the findings is that the characteristics of the childcare services
2 participating in this study may have been protective of excessive weight gain amongst children
3 who attended care. While research examining the relationship between childcare arrangements
4 and child weight status has not been conducted in Australia, such a hypothesis is supported from
5 recent research in the U.S. which found overweight and obesity to be less prevalent among
6 children attending formal childcare than children in family, friend and neighbor care²⁴ If these
7 patterns of obesity risk are substantiated in Australia, research investigating the policies and
8 practices of childcare services which may reduce the risk of excessive weight gain would yield
9 useful information for public health and childcare policy makers and practitioners to maximize
10 the health promotion characteristics of services. Furthermore, such patterns of obesity risk would
11 highlight the importance of targeting child healthy eating and physical activity in other settings
12 such as the home, to reduce the risk of excessive weight gain among children not engaged in
13 formal childcare.

14
15 While geographic associations with overweight and obesity among Australian adults are
16 emerging²⁵, the findings of this study were consistent with a number of Australian community
17 prevalence studies of preschool and school aged children that did not find a significant
18 relationship between overweight and obesity and geographic locality.^{13,26,27} The findings of the
19 study do, however, highlight the importance of socioeconomic disadvantage to the risk of
20 overweight and obesity among children. While there appears to be a consistent, positive
21 association between excess weight and socioeconomic disadvantage among adults,² the results of
22 this study suggest that using maternal education as a measure, such associations begin to manifest
23 in early childhood among children attending childcare. Such findings of are broadly consistent
24 with previous Australian research on community samples of preschool and school aged children
25 which report a higher prevalence rates of overweight and obesity among children from
26 socioeconomically disadvantaged households.^{10,13,26} A lack of obesity prevention interventions

targeting disadvantaged children has been identified in previous reviews of the literature²⁸ This study suggests that child obesity interventions in this setting should be tailored in a way which considers the needs of socioeconomically disadvantaged parents and children, who appear at greater risk of excessive weight gain..

While not significant in multivariate models, the finding of a disparity at the univariate level in the prevalence of overweight between Indigenous and non Indigenous children supports similar findings from earlier research drawn from community samples¹³ Given particularly high rates of obesity among Indigenous adults²⁵, childcare based obesity prevention strategies need to be developed, implemented and evaluated in such a way that they do not exacerbate the gap in overweight and obesity between Indigenous and non Indigenous children in the community, and importantly are directed to closing this gap. Similarly, existing child obesity prevention initiatives should be reviewed to ensure that they are designed and implemented with this goal in mind. The importance of such actions is emphasized by the marked differential in chronic diseases associated with obesity among Aboriginal and Torres Strait Islander peoples,²⁹ and a lack of evidence regarding effective and appropriate prevention initiatives for Indigenous people.

This study is the first to examine socio-economic and geographic associations of overweight and obesity among children attending childcare services in NSW, Australia. The inclusion of other factors known to have an association with child weight status, for example the weight status of parents,³⁰ may have altered the significance of findings reported in this study. Notwithstanding this limitation, the study provides useful information for policy makers and practitioners considering implementing obesity prevention interventions targeting children of this age.

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