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## **Slim Evidence to Suggest Preschoolers Are Emerging From the Obesity Epidemic**

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Over the last few decades, no age group has been spared from the universal rise in obesity prevalence (1-3). According to recent estimates, more than one-half of adults and one in six children are overweight or have obesity in OECD countries (3). In under-five-year-olds, the prevalence of overweight and obesity rose steadily over the 1990s and 2000s, particularly in middle- and low-income countries (4, 5). The adverse consequences of excess weight in childhood are well established. Children with obesity are at risk of increased blood pressure and serum lipids, insulin resistance, orthopedic complications, asthma, and sleep apnea (6); social discrimination (7); and poor psychological wellbeing (8). They face greater odds of economic disadvantage and myriad health problems in adulthood leading to premature morbidity and mortality (9). Though the majority of adults with obesity did not have obesity in early childhood, most children who are overweight at school entry will remain so at the end of their primary school years (10), and the majority of preschoolers with overweight or obesity will be have obesity as adults (11). Hence, young childhood is a critical, vulnerable phase in life for the development of excess weight.

As the prevalence of obesity and obesity-related health consequences have increased, so too have innovations in policy initiatives to tackle the problem. Since 2003, there has been increased interest in intervening in the early years of life to prevent obesity (12). Perhaps as a result, there are pockets of evidence that overweight and obesity levels may be stabilizing or decreasing among younger generations – particularly those aged under five years – while obesity prevalence in adults continues to rise (3). Although earlier data suggest that childhood obesity prevalence may have plateaued in a number of high-income countries (13), in many cases, emerging reports of decreasing overweight and obesity in preschool children do not seem to reflect actual long-term, population-wide changes. Our goal is to clarify and

contextualize these reports, including those that may offer an opportunity to explore and expand policy changes that have contributed to widespread, sustainable obesity reduction.

### **The obesity epidemic**

A conceptual model proposed by Jaacks et al describes 4 stages of the obesity epidemic, each characterized by different trends in obesity prevalence among age, sex, and socioeconomic groups within a population (14). In brief, stage one describes an increase in obesity prevalence to above 5% but below 20% based on WHO growth standards for children 19 years and under, and on  $\text{BMI} \geq 30\text{kg/m}^2$  for adults. This increase is more pronounced in adults compared with children and in women compared with men, particularly those of higher socioeconomic status (SES). In 2016, nearly all countries had at least reached this stage (14). In stage two, adult obesity increases above 20%, with a narrowing of the gap between SES groups, and child obesity prevalence rises to around 10%. Many high-income countries currently appear to be entering the third stage of obesity transition, whereby obesity prevalence continues to rise in groups with lower SES, but begins to plateau in women and children of higher SES (3, 15). Elsewhere, particularly in parts of Asia, child obesity prevalence continues to rise or even accelerate (3, 15). According to Jaacks et al, no countries appear to have reached the proposed fourth stage of the model, characterized by decreasing obesity prevalence in at least some demographic subgroups, particularly children (14).

### **Preschool children are unique**

Incomplete, or otherwise limited, BMI data make it difficult to unequivocally establish preschool obesity trends in many high-income countries, but it seems clear that trends in overweight and obesity in older children cannot be assumed to be similar in preschoolers. Several studies examining changes in prevalence of obesity and overweight over time have

demonstrated different trends for older and younger children in the same population, with more favorable outcomes for children aged under five years (12, 16-19). Although global child overweight and obesity continues to increase among school-aged children, there is considerable heterogeneity between countries (5). In OECD countries, one in five children were reported to be overweight or have obesity in 2014 (20), but only one in six in 2017 (3).

Interventions and prevention efforts for early childhood obesity vary greatly in their setting, duration, and content, but often do not result in changes in BMI or are evaluated in relation to outcomes other than body measurements (eg, behavior changes) (12, 21, 22). Thus, their effect on obesity in the long term remains unclear. There is increased recognition that the first few years of life could be the most crucial for establishing healthy weight trajectories (23), and due to the limited success of obesity treatment in childhood, prevention is a key focus for reducing obesity prevalence (24, 25). Overall, the longer a child spends in obesogenic environments, the greater their risk of becoming overweight (26). Correspondingly, there is emerging evidence to support the belief that interventions and prevention efforts have more potential to reduce obesity risk when begun earlier in life (23, 24). Pregnancy and the postnatal period have been described as a “teachable moment” for lifestyle interventions, due to mothers’ increased concern with health and wellbeing and contact with health services (27). A growing understanding of fetal origins of obesity risk has led to the design of interventions targeting children who may be at increased risk for becoming overweight before they are even born (28).

### **Is the tide turning? Examination of reports that contradict global trends**

The popular media have been quick to amplify scattered messages that our youngest children may be beginning to emerge from the obesity epidemic. Among reports of increasing obesity

in preschoolers on a global scale (5), researchers have described a small number of exceptions in parts of Europe (29-31), North America (16, 32, 33), Australia (34), and New Zealand (35). The majority of the studies and datasets described below use World Health Organisation (WHO) or Obesity Task Force (IOTF) growth references and obesity definitions, but data from the UK, USA, and Germany describe obesity prevalence based on growth standards established in local populations. Therefore, the focus of the following section is to describe trends over time within populations, and absolute obesity prevalence should not be assumed to be directly comparable between populations described.

#### *Reports from small populations*

A small number of published reports indicate decreasing overweight or obesity in young children from individual cities, provinces, or counties (29, 31, 32). In Aberdeen, the described change was large; the proportion of children starting school with BMI in the obese range fell by almost a third from 14.7% to 10.2% between 1997 and 2004 (31). However, more recent reports from Aberdeen suggest that obesity prevalence for children starting school in the 2018/19 term was over 16% - higher than in 1997 (36).

In a Northern Swedish county, there was a decrease over the mid-2000s in overweight prevalence in four-year-old boys and girls (from 17.2% to 14.2% and from 22.3% to 19.0%, respectively), and obesity prevalence in girls (from 5.7 to 3.1%) (29). In Newfoundland and Labrador, mean BMI decreased between 2001/2 and 2009/10 for children in their first year of primary school, though this trend did not reach significance for girls (32). A similar trend was reported in Alberta (37). The Alberta study was the only one to include socioeconomic demographics, and reported that most reductions were driven by children from higher income

families (37). Without further data it is difficult to ascertain whether these effects have been sustained, or whether they reflect trends in the wider Swedish or Canadian populations.

### *Intervention studies*

Two city-wide intervention studies have recently attracted significant media attention for their initially promising effects on childhood obesity: the Amsterdam Healthy Weight Program (38), and the HENRY (Health Exercise Nutrition for the Really Young) program in Leeds in the UK (39). The Amsterdam Healthy Weight Program is a multi-level approach to obesity prevention, targeting individuals, schools, and neighborhoods to create environments where healthy choices are facilitated, and HENRY provides training to people working with young families as well as workshops and resources to families directly. Both programs targeted higher-risk children and described greater improvements in obesity prevalence among the targeted groups compared with other children in the community. However, more recent data have suggested that any apparent effects of the interventions were either short term, or perhaps an optimistic interpretation of year-to year variation.

HENRY's success was evaluated using data from England's National Child Measurement Programme to demonstrate a decrease in obesity prevalence for reception children in Leeds between 2009/10 and 2016/17 (39). According to the same data, as of 2018/19 Leeds is experiencing its highest levels of overweight and obesity in a decade among children beginning school (40). Similarly, three-year data from the Amsterdam Healthy Weight Program demonstrate mixed results. Although there have been improvements in city planning, citizens' lifestyles, and attitudes since its introduction in 2013 (38), 9.6% of two- and three-year-olds in Amsterdam were overweight in 2017 compared with 8.8% in 2012 (21).

In the US, BMI data dating back to 2000 have been reported for children participating in supplemental nutrition programs (41). The Special Supplemental Nutrition Program for Women, Infants and Children (WIC) evaluation assessed changes in the BMI of two- to four-year-olds enrolled in the program. In this group, obesity prevalence appeared to decline between 2010 and 2014, with the trajectory change coinciding with improvements to food packages provided through the program as well as an increase in the number of eligible children following the 2008/2009 financial downturn (41). Though WIC data have been assumed by some to be representative of wider trends (42), nationally representative NHANES data describe an increase in obesity among two- to five-year-old children over a similar time period (43). Additionally, only around one-half of eligible children are enrolled in the WIC program (44), so it is not clear whether these data may be generalized even to other low-income families in the US. With a comparatively small sample size, the NHANES data has limited scope to describe obesity trends reliably within smaller age or ethnicity subsets of the sample, particularly over shorter time periods (45, 46).

*Data from well-child checks and child measurement programs*

Data from the National Child Measurement Programme in England demonstrate that between 2006/07 and 2018/19, overweight and obesity, but not extreme obesity, decreased for boys beginning school (four to five years old) (47). However, the magnitude of change was dependent on socio-economic status, with no change in overweight and obesity prevalence for those living in the highest deprivation quintile and more pronounced decreasing trends for those living in areas of low deprivation. For girls, overweight, obesity, and extreme obesity increased slightly over the same time period. This national trend seems to be driven primarily

by those living in the most deprived quintile, and overweight and obesity have begun to decrease among girls living in the least deprived quintile (47).

In the Australian state of Victoria, overweight and obesity data from health checks of 3.5-year-old children showed a decrease in prevalence from 18.5% in 1999 to 15.4% in 2007 (34). However, both attendance of the health checks and availability of electronic data changed considerably over the same period, so data from earlier years include fewer children than later years ( $n = 3314$  in 1999,  $n = 16,281$  in 2007) (34). Data demonstrating more recent trends in this population or addressing some of these limitations are not yet published.

In New Zealand, attendance of the four-year health check (B4 School Check) is near-universal (35). Overweight, obesity, and extreme obesity decreased among children attending the B4 School Check between 2010/11 and 2015/16 (35). Although there were marked differences between communities in overweight and obesity prevalence, this decline was significant across all sex, ethnicity and socio-economic groups analysed with the only exception being a significant decrease in obesity and extreme obesity, but not overweight prevalence, for children living in rural areas (35).

In Germany, where health check attendance is similarly high, the CresNet database includes anthropometric measurements for over 300,000 children from routine medical checks (30). Among these children there was a significant decrease in the prevalence of overweight (including obesity) in children aged four to eight years between 2004 and 2008 (30). Data were not analysed separately for under-fives alone, but younger children were likely over-represented in this sample due to higher attendance of health checks. The downward trend continued until 2010, and prevalence remained stable at around 10-10.5% between 2010 and

2015 (48). This appears to be the only dataset demonstrating a nationwide decrease in obesity prevalence in young children with data spanning more than a decade. However, though the data are believed to be nationally representative, demographic information was not available to compare trends by SES or ethnicity groups (30).

### **Are there lessons to learn from successful countries?**

We have described data that suggests a small number of high-income countries are approaching or have already entered the proposed fourth stage of the obesity epidemic, where obesity prevalence begins to decline in some segments of the population (14). Consistent with the model of Jaacks et al, it is primarily those at lowest risk for obesity and concomitant health problems who appear to be emerging from the epidemic while higher-risk groups may be left behind. For example, in the UK inequalities in the burden of excess weight have increased (47). It seems that only children from families with the resources to respond to public health messages have benefitted from local and international strategies to tackle rising obesity. So far, New Zealand is the only country we are aware of to report a recent population-wide reduction in preschool obesity with data demonstrating that the decrease is not accompanied by increasing ethnic or socio-economic disparities.

In order to understand what changes may have preceded the nationwide decrease in early childhood overweight and obesity prevalence in countries such as NZ, Australia Germany, it is first necessary to determine *when* these changes took place, and how they may differ between sub-groups. This is a challenge in most countries. In New Zealand and Australia, the prevalence of overweight and obesity in pre-schoolers has been decreasing since comprehensive preschool anthropometric data collation began, so it is difficult to know at what point prior to data collection the downward trend began. Findings from the New

Zealand Health Survey, which first collected height and weight of two-to four-year-olds in 2006/07 then annually from 2011/12, indicate that overweight and obesity prevalence in preschoolers was highest in 2006/07, though with a considerably smaller sample size and broader age range the data are not directly comparable with the B4 School Check data described above (49). In Germany, the decrease appears to have begun around 2004 for children aged 4 to 8 years, with 8-12 year-olds perhaps beginning to follow suit more slowly (48). Although preschool obesity may be decreasing in other high-income countries, there is a clear need for better availability of data to understand trends before it is possible to either determine the cause of any positive changes or make any predictions about the future of obesity-related illness. It is possible that attitudes and awareness have changed on an international scale, resulting in changes to obesity risk in locations or demographic groups where infrastructure exists to support healthy choices.

In New Zealand, the changes across all demographic groups suggest that society-wide changes have contributed to reduced risk of obesity in early childhood, or that targeted intervention in the highest risk groups was effective alongside an overall societal shift. Examination of broad-reaching developments preceding the changes in overweight and obesity trajectories may help to understand, improve, and expand those that are effectively contributing to obesity prevention. Changes to policies relating to food advertisement, taxes, and labelling; supports for parents; and early childhood education, for example, should be compared between different countries to identify common and disparate elements.

For example, in the mid-2000s New Zealand doubled spending on early childhood education (ECE), providing 20 hours of free care for three-and four-year-olds, and changing funding models to incentivise centres to increase staff qualifications (50). Particularly in communities

at higher risk for obesity, both ECE participation for children and registration of ECE teachers increased (51). Concurrently, household spending on childcare relative to income dropped considerably, with childcare estimated to be around a third more affordable to New Zealand families (52). Comparing early childcare experiences for children in New Zealand with international communities could give insight into whether this is one of the factors contributing to changing obesity trends in early childhood.

## **Conclusions**

Though we may be beginning to see early signs that overweight and obesity is beginning to stabilize or decline for some young children, these cases remain the exception globally. The peak of the “obesity epidemic” may still be yet to come, particularly in low-and middle-income countries (1-3, 5). In addition, evidence of increases in health inequalities is emerging in many countries affected by the COVID-19 pandemic. As the full consequences of the pandemic and resulting financial recession begin to be realised, these inequalities are likely to worsen (53), which may stall progress in addressing childhood obesity, particularly in more deprived communities. It should also be noted that the decreases that have been documented are small; overweight and obesity prevalence remains high among preschoolers, even in countries beginning to see positive changes in prevalence. In New Zealand, for example, one in three children is overweight and 15% have obesity before they begin school (35). However, though successful obesity reduction on a wide scale is rare to date, it may be replicable if the causes can be identified and adapted to different contexts.

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