Childhood Obesity and Delayed Gratification Behavior: A Systematic Review of Experimental Studies

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Objective To evaluate the extent of the association between instant gratification behavior and childhood obesity.
Study design PubMed, Scopus, EMBASE, EBSCOhost, and Cochrane databases were searched for the terms delayed gratification, children, and obesity. Studies were eligible if they included a sample of at least 100 children who were made to choose between an immediate reward and a larger one later, with the authors comparing the response in different populations and observing some relationship with obesity. A specifically designed data extraction form was used, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. The methodologic quality of the included studies was assessed with the methodologic index for nonrandomized studies.
Results Nine articles were included after we applied the inclusion and exclusion criteria. Almost all studies conducted the test in populations of preschool children and offered food and/or nonfood rewards. The studies found a clear relationship between an inability to defer gratification and overweight and obesity. The quality assessment of the publications was ranked high in 5 studies and medium in 4.
Conclusions Children with the inability to delay gratification are more likely to be overweight or obese. Observation of such trends is useful in its implications for reeducation programs. Although the methodologic quality of the eligible studies was acceptable, additional experimental controlled studies are required to associate these behaviors with other aspects. *(J Pediatr 2016;169:201-7)*.

Delayed gratification behavior is a social ability that involves being able to resist the temptation to take a smaller but more immediate reward and to wait for a larger, more permanent reward later.[1] A growing body of literature has linked the ability to delay gratification to a host of other positive outcomes, including academic success, physical health, psychological health, and social competence.[1] A person's ability to delay gratification relates to other similar skills, such as patience, impulse control, self-control, and willpower, all of which are involved in self-regulation.[1]

The seminal research on delayed gratification—the now-famous "marshmallow experiment"—was conducted by Walter Mischel in the 1960s and 1970s at Stanford University.[2,3] Those children who were able to wait longer demonstrated a striking array of advantages over their peers when they were re-evaluated as teenagers and adults. As teenagers, they had greater SAT scores, social competence, self-assurance, and self-worth and were rated by their parents as more mature, better able to cope with stress, more likely to plan ahead, and more likely to use reasoning.[3] They were less likely to have conduct disorders or high levels of impulsivity, aggressiveness, and hyperactivity.[4] As adults, high delayers were less likely to have drug problems or other addictive behaviors, to get divorced, or be overweight.[5]

Forty years after the first marshmallow test studies, neuroimaging data have shed light on the neural correlates of delayed gratification. Those who had been high delayers as preschoolers were more successful at controlling their impulses. Using functional magnetic resonance imaging, Casey et al[6] also scanned the brains of 26 participants as they completed the task. Results show differential brain activity.[7]

There has been a recent increase in research linking the ability to defer gratification with obesity in children. The aim of this systematic review was to determine the extent to which immediate gratification behavior is associated with obesity in childhood. We report a critical analysis in which we evaluate the common diagnostic criteria used in applying protocols of this kind and assess the scientific quality of the studies so far published in the field of delayed gratification in obese children.

Methods

The present systematic review included studies that fulfilled the inclusion criteria using the patient characteristics, type of intervention, control, and outcome format,[8] namely, identifying the patient problem or population (any human study or clinical research that included a sample of at least 100 children between 3 and 15 years of age), intervention (the performance of a delayed gratification test in children that involved making a choice between a reward granted immediately and a larger one later), comparison (those studies that compared

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the responses to the delayed gratification test in different populations of children), outcome(s) (observation of the relationship between choosing immediate rewards and obesity), and study design (controlled clinical trials, experimental, or cohort controlled studies). Case reports were excluded, as were case series, descriptive studies, reviews, letters, comments, articles that did not correspond to the objective of this review, and studies that failed to give an adequate description of the delayed gratification test.

We based our research on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (http://www.prisma-statement.org). Using the MEDLINE database (Entrez PubMed; http://www.ncbi.nlm.nih.gov/), we examined articles published before October 2014 and used the following Medical Subject Headings: "delay gratification" and "children" or "delay gratification" and "obesity." After the electronic literature search, abstracts were used as the basis for screening and making a selection. Articles initially were selected on the basis of title and abstract, with the complete article being reviewed whenever there was any doubt as to whether it should be included. Conflicts between examiners were resolved by discussing each article to reach a consensus. Afterward, a manual search was conducted to identify potential studies not included under the aforementioned criteria. The Scopus, EMBASE, EBSCOhost, and Cochrane databases also were explored to find possible papers that matched our established selection criteria.

Two experienced reviewers assessed the methodologic quality of the selected studies and resolved discrepancies by discussion until consensus was reached. Each of the studies found in the search was analyzed with the methodological index for non-randomized studies.[9] To summarize, all studies were graded with the global score derived from the methodologic items of nonrandomized studies. These items were scored as follows: 0 (not reported), 1 (reported but inadequate), or 2 (reported and adequate). The ideal global score was 16 for noncomparative studies (0-4: low quality, 5-10: medium quality, 11-16: high quality) and 24 for comparative studies (0-8: low quality, 9-16: medium quality, 17-24: high quality).

Data were collected for the following elements: author and year; study design; sample (size, sex, age, measure of obesity); design of delayed gratification test (kind of reward, waiting time, reward in sight); results; conclusions by the authors; and citations received. Available summary results were then tabulated.

Results

The electronic search identified 119 titles and abstracts. An overview of the selection process is provided in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses flowchart (**Figure**; available at www.jpeds.com). Nine articles were included after the inclusion and exclusion criteria were applied. Almost all the excluded articles did not follow the objective of this systematic review. Good interobserver concordance between the 2 experienced operators (kappa index: 0.88) was observed.

Table I presents the main characteristics of the studies. Three[5,10,11] of the 9 studies included in this systematic review were case-control studies (33.3%), and the rest[12-17] were cohort studies (66.6%). The measure of obesity used in most of the studies (77.7%)[5,10-14,16] was body mass index (≥25, overweight; ≥30, obese); however, 2 of the studies in this review[15,17] measured obesity by the use of skinfold thickness, which defines obesity between 6 and 17 years of age in terms of values exceeding 25% of body fat for men and 32% of body fat for women (**Table I**).

Most of the studies[10-13,16] included in this systematic review used a reward involving food in the test of delayed gratification. In just 3 studies,[5,15,17] the children were offered both food and nonfood rewards. Graziano et al[14] used only nonfood rewards in their study, offering a box with a gift inside (**Table I**). The time to wait for the later larger reward varied between the different studies in the review. We observed a difference of 2-30 minutes[5,10,12-14,16]; however, in the studies of Sobhany and Rogers[17] and Johnson et al[15] the larger reward was given the next day. Only one study[11] failed to specify the time spent waiting (**Table I**). With regard to whether the children were allowed to see the mentioned reward, all the studies complemented verbal suggestion with a direct visual observation of the expected reward (**Table I**).

All the studies found a clear relationship between an inability to defer gratification and being overweight or obese. Schlam et al[5] found that performance in terms of the ability to defer gratification accounted for a significant proportion of the variance in body mass index (4%, $P < .01$). Each additional minute that a child delayed gratification predicted a 0.2-point reduction in body mass index in adulthood. Graziano et al[14] observed this association with an OR of 1.74 ([1.07-2.86], $P < .05$). Using multiple logistic regression, Seeyave et al[16] documented that children who failed the delayed gratification test were more likely to be overweight at 11 years of age, with a relative risk of 1.29 (95% CI 1.06-1.58; **Table I**).

Most of the studies[10-13,16] in this review offered children only edible rewards. The studies that used food and nonfood rewards observed different types of responses. Sobhany and Rogers[17] observed that obese children had lower scores than their nonobese peers when it came to deferring gratification on food items, although obese and nonobese children were not significantly different from each other in that study with respect to their ability to wait for nonfood items. In general, both obese and nonobese subjects delayed longer for food items than for nonfood items. Moreover, in the ANCOVA, the same researchers indicated that the duration of abstinence from food had no significant effect on the children's ability to delay gratification for food items ($P < .15$). There were significant differences for age ($F [1.476] = 34.24$, $P < .001$), body size ($F [1.476] = 8.29$, $P < .005$), type of item ($F [1.476] = 12.38$, $P < .001$), and body size by type of item interaction ($F [1.476] = 4.19$,