



REVISIONES

Effect of infant temperament on the weight of preschool children: a systematic review

Efecto del temperamento infantil en el peso del niño preescolar: una revisión sistemática

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ABSTRACT

Background: Temperament is a variable that has recently been shown to be of interest as a risk factor for childhood obesity. Some studies indicate that difficult temperament is associated with weight gain in preschoolers.

Objectives: The aim of the present study was to analyze the available literature on the association between the child's temperament and the BMI of the preschool child.

Methods: We did a review of the literature about studies evaluating the association among temperament and body mass index in the preschool child. The search was carried since May to June of 2016 in databases such as Pubmed, EBSCO Host, Ovid, Springer Link and academic google. We included studies that had not more than 10 years of published and that complied criteria for inclusion, in addition the results of the studies had quality in the methodology and results, as reference for the evaluation of the studies, we used The Critical Appraisal Skills Program English.

Results: We found 784 articles, of which only nine were included for this review, six of the studies evaluated temperament based on attentional reactivity and / or traits, three evaluated temperament based on self-regulation of the child and only one Evaluated both emotional reactivity and self-regulation. It seems that negative reactivity and low self-regulation are factors associated with childhood obesity in the preschool age.

Conclusions: The literature suggests that more research is needed to determine the temperament behavior around obesity in children.

Keywords: Temperament; Pediatric obesity, Body Mass Index

RESUMEN

Antecedentes: El temperamento es una variable que recientemente ha resultado de interés por considerarse un factor de riesgo de la obesidad infantil. Algunos estudios señalan que el temperamento difícil se asocia al incremento del peso en los preescolares.

Objetivo: Analizar la literatura disponible sobre la asociación entre el temperamento infantil y el IMC del niño preescolar.

Métodos: Se realizó una revisión de la literatura sobre estudios que evaluaran la asociación entre el temperamento e índice de masa corporal en el niño preescolar, la búsqueda se realizó en los meses de mayo y junio del 2016, en bases de datos como Pubmed, EBSCO host, Ovid, Springer Link y Google académico, se incluyeron estudios que no tuvieran más de 10 años de haberse publicado y que cumplieran con los criterios de inclusión y calidad en la metodología y resultados presentados, como referencia para la evaluación de los estudios se utilizó la guía Critical Appraisal Skills Programme Español.

Resultados: Se encontraron 784 artículos, de los cuales solo nueve se incluyeron para esta revisión, seis de los estudios evaluaban el temperamento en base a la reactividad atencional y/o rasgos, tres evaluaban el temperamento en base a la autorregulación del niño y solo uno evaluó tanto la reactividad emocional como la autorregulación. Pareciera que la reactividad negativa y la baja autorregulación son factores asociados a la obesidad infantil en la edad preescolar.

Conclusiones: La literatura encontrada sugiere que es necesaria mayor investigación para determinar el comportamiento del temperamento en torno a la obesidad en los niños.

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Palabras clave: Temperamento; Obesidad pediátrica; Índices de masa corporal

INTRODUCCION

Childhood obesity (OB) is considered an alarming health problem. If not treated, it can cause many diseases. These diseases include, but are not limited to, diabetes mellitus, cardiovascular diseases, cancer, diseases of the locomotor system, anxiety, depression and even premature mortality. This has a big impact in the economy for the countries who suffer any of the aforementioned diseases as a result of OB. The annual expenditure of the treatments to both complications and diseases generated by OB, in addition to the loss of labor force at an earlier age, is insurmountable ⁽¹⁾. Research continues to seek understanding as to why there is such a significant weight increase in childhood, despite the current knowledge available about the main risk factors for people who are overweight (OW) and/or have OB. It is no surprise that the current known factors are food consumption with high caloric content, insufficient physical activity, as well as multiple genetic and environmental factors. These three alone are already known as the main causes of excessive weight gain during childhood ⁽²⁾.

During the first five years of life, our feeding behaviors are learned, specifically honing in on the preferences and rejections to certain foods, as well as the reputable patterns of physical activity ⁽³⁾ that are observed by the children through their mother. She is the main role model and should advocate positively in order to succor her children's eating and activity choices. However, the biological, genetic, and psychological characteristics of the child could also influence the maternal decisions related to the feeding behaviors that they promote. In the case that their choices are not healthy, this could also be a contributing factor increase in his/her weight until he/she becomes OW-OB. One example is the infant temperament, which has been associated with the rapid increase of weight in infant and preschool children. Since mothers who report it have children with difficult temperament, they refer to feeding them frequently to calm them. Therefore, the children that manifest those particular temperaments and

characteristics are automatically predisposed to unhealthy behaviors, such as maternal overfeeding^(4,5).

Temperament can be defined as a stable and durable trait that has biological bases. It's also linked to genetic endowment of each individual and determines affect, attention and motor responses in different situations. The manifestations of temperament are modified over time due to interaction with the parents^(6,7). Temperament constitutes an individual difference between two components: attentional reactivity and self-regulation. Attentional reactivity refers to the characteristics of personal reactions given by changes in the environment. These are reflected through the somatic, sympathetic, endocrine and nervous system, which can lead to two results. The negative result would present with the child expressing and perceiving anger characterized by aversion. The positive result would present with the child expressing positive affection and behavior characterized by attentional focus. On the other hand, self-regulation includes functional processes that modulate a specific reactivity. For example, attentional patterns, such as focus and avoidance may be the reactivity observed⁽⁸⁾. The development of self-regulation will result from the increased control over the attentional process, as well as, the inhibitory control over motor behavior. As a result, two self-regulation skills have been identified. Those skills consist of emotional regulation and delayed reward⁽⁹⁾.

Literature has documented how the different types of temperament and its processes can affect the food consumption of children. When this surpasses his/her energetic needs, it could result in weight gain. Temperament has been evaluated in different ways, through trials, which reflect the responses that are given to attentional reactivity. One study found that the ability to self-calm, in addition to having a non-attentional capacity, were predictors to preschool girls and boys being identified as overweight⁽¹⁰⁾. Another study showed that the child's difficult temperament, or negative reactivity, was associated with his/her excess weight problem. This automatically increases when the mother continuously feeds her child as a means of calming him/her⁽⁵⁾. An additional study found that children with low inhibitory control⁽¹¹⁾ and low delay in reward⁽⁹⁻¹¹⁾ were less likely to use strategies to redirect their preferences to desirable foods, which resulted to an increase in his/her weight over a sustained period of time. Nevertheless, other studies reported that child temperament is in no way concomitant with weight gain in preschool aged children⁽¹²⁻¹³⁾.

Existing literature reports that temperament is an interesting variable that could foster a better understanding of the obesity phenomenon in preschool children. Therefore, it is important to carry out a review of theoretical and methodological studies on preschool temperament and its effect on the child's body mass index (BMI). Our current knowledge is that there is only one systematic review, which includes the adjustable feeding practices⁽¹²⁾. However, our attention is to investigate to see if there is a direct association between temperament and the BMI of preschool children, making sure it is carried out independently of other moderate variables. The key objective of the present study is to analyze and synthesize the existing literature about the variable infant temperament, which includes attentional reactivity, self-regulation or both, in association with the OW-OB of preschool children, while at the same time, considering their BMI as an outcome.

METHODOLOGY

This systematic review was performed following the basic guide check list proposed by the PRISMA group of 27 items ⁽¹⁴⁾. Previously, a literature review was completed to be able to recognize the importance and the objective of it, which followed the parameters proposed by PICOS (Patient, Intervention, Comparison, Results and Study Design).

Inclusion criteria was set: Studies would evaluate the temperament and childhood obesity correlation in children 3 to 6 years old, with the variable result being the children's BMI. The study designs were comprised of correlational, longitudinal, systematic review, or meta-analysis descriptors that were published in either English or Spanish after 2006. The search was performed in selected electronic databases such as: PubMed, EBSCO host (Medline, Health Source, Nursing/Academic edition, Medic Latina, CINAHL), Ovid, Springer link, as well as, Academic Google search. These searches used the keywords: pediatric obesity, childhood obesity, child obesity, temperament, body mass index, "AND", "OR", and "NOT". These key words were identified by DeCS and Mesh Health Sciences Descriptors.

[Box 1 Search strategy]

Search strategy MEDLINE, PubMed
#1 "Pediatric obesity" [ti]
#2 "Childhood obesity" [ti]
#3 "temperament" [ti]
#4 #1 OR #2 AND #3
#5 not teenagers
#6 #4 NOT #5

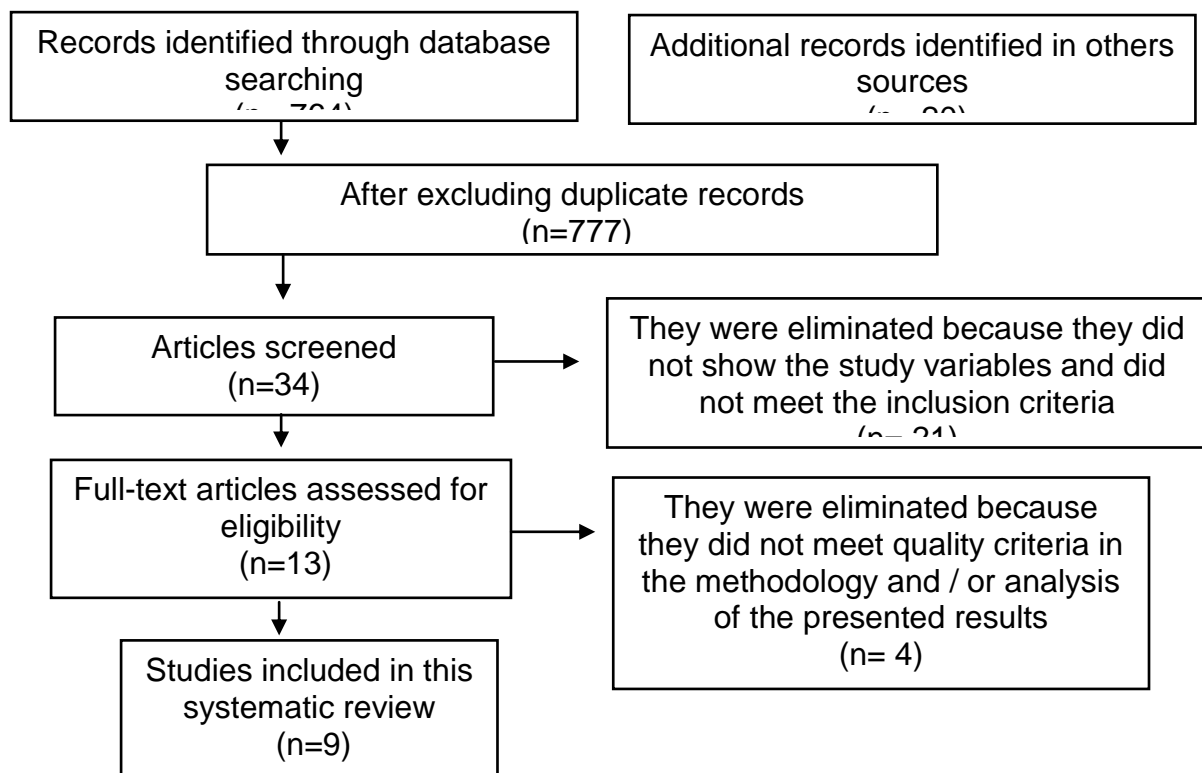
The procedures for selecting the studies were based on keywords and Boolean operators being placed in the selected databases. The duplicate citations were then eliminated, and after that, those studies that included interest variables in their title were selected. Next, their summary was evaluated, and those articles that did not meet the inclusion criteria were excluded. Subsequently, the remaining studies were evaluated in full text using two methods: 1) by paragraphs and 2) by questions, from the template CASPe (Critical Appraisal Skills Program Spanish). Sections were revised as follows: the title should be well defined and correctly drafted, as well as, include the variables that are to be investigated. The abstract had to at least show the objective, methods, results and conclusions, all while maintaining congruency, in addition to, inclusion of the keywords from the article.

The introduction should present an adequate approach to the problem, be contextualized, and include the objective, hypothesis or purpose. The sample was then randomly selected in relationship to the methodology that was adequate to answer the objective of the study. The description of the instruments used and the analysis of data that was congruent to the design and objective of the study were also incorporated. The results manifested answers to the objectives and conclusions established the limitations of the study. In relationship to the CASPe template, the questions were as follows: Were the results measured accurately to minimize possible bias? Did the authors consider the potential effect of confounding factors in the design and/or analysis of the study? Do the results of this study concur with other available evidence?

RESULTS

There was a total 784 studies found, 7 of which were excluded because they were duplicate citations. Of the remaining 777, only 34 studies were selected. One reason for that selection was that the variable of interest for this review was contained in the title. On the other hand, 21 were eliminated because they did not meet the inclusion criterion that was established. Therefore, they were evaluated in full text. Subsequently, of the remaining 13 articles, 4 were deleted. This deletion occurred for not meeting the quality criteria in the methodology and/or analysis of the results presented. Hence, 9 studies were integrated in this systematic review. The prism diagram is attached (figure 1).

[**Figure 1** Prism Diagram, used for the article selection included in this systematic review]



Characteristics of the studies

Of the nine studies reviewed, seven were conducted in the United States^(5,9,10,11,15,16,17), one in Australia⁽¹²⁾, and one in the United Kingdom⁽¹³⁾. Regarding the design, three of the studies were of transverse design,^(13, 15,16) while six were longitudinal^(5, 9, 10, 11, 12, 17). These studies have a follow-up of 2 to 10 years.

The participants were Caucasian, African American, and Hispanic. The vast majority of the studies got measurements of mothers and their children (dyads)^(12,10,5,13,9). Others got measurements of both parents and their children^(15,16,17). There was a single study that included only children⁽¹¹⁾. The classification of the child's BMI was done in accordance to the CDC^(5, 9,10,11,12,15,16,17). One study, however, performed the BMI classification per the WHO Child Growth Standards⁽¹³⁾. The findings of these studies are presented in a table.

[Table I Individual analysis of data from selected studies]

Author-Year	Study design	Sample	Measuring instrument	Association between Temperament and Child's BMI
Bergmeier, 2014 ⁽¹²⁾	longitudinal	201 Dyads mothers and children (2-5 years)	The short temperament scale -Cooperation -Irritability -Focus Reliability: ($\alpha=0.82-0.85$)	No significant association was found
Graziano, 2013 ⁽⁹⁾	longitudinal	195 children and mothers (2,4,5,7 y 10 years)	Toddler behavior assessment questionnaire Dimensions: -Activity Level -Pleasure -Social fearfulness -Anger -Interest / persistence Reliability ($\alpha=0.84$) Emotional regulation: -A child's favorite toy was placed in a closed box and asked to wait for 2 minutes -The child was placed in a high chair, with no toys for 5 minutes (Kappa .80) ($r= -.91$, $p<.001$) Reward sensitivity -Measured the time it takes the child to approach and open an attractive wrapped box, which was told that it was a gift for him ($r= .99$) Sustained attention -A video of 5 minutes was placed and the time that the child spent watching a video was measured, without losing the attention ($r = .98$)	At 4 years, a significant relationship was reported between temperament / self-regulation abilities (emotional regulation, reward sensitivity and sustained attention) which were positive predictors of BMI at 10 years ($\beta=0.31$, $p <0.0001$)

Author-Year	Study design	Sample	Measuring instrument	Association between Temperament and Child's BMI
Wu, 2011 ⁽⁵⁾	longitudinal	1201 children and their mothers (2-12 years)	<p>Infant temperament questionnaire</p> <ul style="list-style-type: none"> -Approach -Activity -Intensity -Mood -Adaptability <p>Reliability ($\alpha=0.81$)</p> <p>The children were grouped into the three categories (difficult, easy and shy child)</p> <p>1 Easy child: defined as high Rhythmicity, approach and adaptability, low in intensity and positive mood</p> <p>2 Difficult child: low rhythmicity, approach and adaptability, high intensity and negative mood</p> <p>3 Children slow to react / shy children: low activity, approach adaptability, high intensity and negative mood</p>	<p>No relationship was reported between the child's type of temperament and BMI, it was until the variable sensitivity / insensibility of the mother was added, when significant statistics were shown</p> <p>We found a relationship between a high BMI of the school-age child (5 to 12 years), being a shy child and having an insensitive mother ($\beta=4.756$, $p<0.01$)</p> <p>There was a relationship between a high BMI of the school-age child (5 to 12 years), being a difficult child and having an insensitive mother ($\beta=4.866$, $p < 0.05$)</p>
Hughes, 2008 ⁽¹⁵⁾	Cross-sectional	718 Parents of children (3- 5 years)	<p>The children's behavior Questionnaire (very short form) (CBQ)</p> <ul style="list-style-type: none"> - Negative affectivity ($\alpha=0.65$) - Effortful control ($\alpha=0.74$) - Surgency/extraversion ($\alpha=0.63$) 	<p>A multivariate analysis of the variance between the variables: associated with the child's weight (ethnicity, gender and parental BMI), demographic (parental education, parental age and child's age), psychosocial (temperament of the child and affection of the mother) and the indulgent style of feeding, the model predicted the BMI of the child in a 12%.</p>

Author-Year	Study design	Sample	Measuring instrument	Association between Temperament and Child's BMI
Haycraft, 2011 ⁽¹³⁾	Cross-sectional	241 Dyads (mothers and children to 3-8 years)	Temperament Survey for children (EAS) -Shy -Emotionality -Sociability -Activity Reliability ($\alpha=0.58-0.83$)	The child's BMI was not significant with any of the temperament traits
Graziano, 2010 ⁽¹¹⁾	longitudinal	57 children (de 2 a 5.5 years)	Emotional regulation: -A child's favorite toy was placed in a closed box and asked to wait for 2 minutes -The child was placed in a high chair, with no toys for 5 minutes (Kappa .80) ($r= -.91, p<.001$) Sustained attention -A video of 5 minutes was placed and the time that the child spent watching a video was measured, without losing the attention ($r = .98$) Reward sensitivity -The time it took the child to approach and open an attractive wrapped box was measured, which was said to be a gift to him ($r= .99$)	Emotional regulation was a significant predictor of the child's BMI at 5.5 years ($\beta= -.41, p <.01$) Inhibitory control / reward sensitivity was also a significant predictor of child weight at 5.5 years ($\beta=-.17, p<.05$)

Author-Year	Study design	Sample	Measuring instrument	Association between Temperament and Child's BMI
Tan, 2010 ⁽¹⁶⁾	Cross-sectional	63 Parents and children (3-9 years)	Food self-regulation -Eight items developed based on the existing literature review. For example: My son knows how much food he should eat, my child stops eating when he feels full, etc. Reliability ($\alpha=0.87$) Inhibitory control -The children's behavior questionnaire (CBQ) Stress management subscale Reliability ($\alpha=0.85$)	A negative and significant relationship was found between food self-regulation and the child's BMI ($r=-.29, p=.05$).
Francis, 2009 ⁽¹⁷⁾	longitudinal	1061 Families and their children (3,5,7,9,11 y 12 years)	-Procedure for measuring self-control in children aged 3 years -The estimated reliability among qualifiers was 0.92. -Procedure for measuring delay in gratification	Children with low self-regulation in both procedures had a faster weight gain (3 to 12 years) (BMI z score $_{\Delta 3-12}=0.57+0.05$) Children who were under both Procedures gained significantly more weight over time than children who only had low gratification delay (BMI z score $_{\Delta 3-12}=.40 + .05$; $t = 0.06$; $P < .05$) and that children who have high self-regulation and high delays in gratification (BMI z score $_{\Delta 3-12} = 0.32+ 0.05$; $t= 3.76$; $P< .001$). Finally, children with low self-regulation Had significantly higher BMI z-score gains over time (IMC z score $_{\Delta 3-12} = 0.50+ 0.07$) compared to children who had high regulation and high delays in gratification ($t = 1.95$; $P<.05$)

The synthesis of results for the selected studies were constructed by dividing them into two categories: 1) those that reported temperament through reactivity/traits and 2) those that reported temperament through self-regulation.

Temperament (Reactivity/Traits)

Six studies assessed attentional reactivity and temperament traits. Regarding the theoretical support of the studies, three of them used the definition given by Rothbard

and his collaborators. They established that the temperament is a stable and lasting trait that has biological bases, in addition to being linked to the genetic endowment of each individual. This then determines the affective, attentive and motor responses in different situations ^(cited in 9, 10.5). One study used the definition proposed by Sanson (1987) ^(cited by 12), who established three dimensions for evaluating temperament: emotion/affectivity, self-regulation/effort control, and positive affect/focus ⁽¹²⁾. Another study refers to the definition given by Buss and Plomin's (1977). They defined it by ascertaining that the child temperament can be classified into four characteristics: shyness, emotionality, sociability, and activity ^(cited by 13). A third study considers the criteria established by Sadness, who suggests that there are three dimensions of one's temperament: negative affectivity, effort control, and extroversion/insurgency ^(cited in 15). It should be noted that one of the studies referred to more than one author as a theoretical support of temperament. First, they made use of the definition proposed by Rothbard. Next, they used the dimensions of temperament proposed by Thomas and Chess (activity level, rhythmicity, focus/retraction, adaptability, intensity, mood, persistence/attention span, distraction, and the threshold of responsiveness). Last, but not least, they used the typologies by Dixon and Smith (2000) Maziade, Caron, Cote and Merette (1990) that classified children as: easy child, difficult child and shy child ^(cited by 5).

The questionnaires applied, which are all comprised of acceptable reliability were: 1) The Short Temperament Scale ⁽¹²⁾, 2) Toddler Behavior Assessment Questionnaire ⁽⁹⁾, 3) Colorado Child Temperament Inventory⁽¹⁰⁾, 4) Infant Temperament Questionnaire ⁽⁵⁾, 5) The Children's Behavior Questionnaire (CBQ) ⁽¹⁵⁾, and 6) Temperament Survey for Children ⁽¹³⁾.

In the relationship between temperament and a child OW-OB, two of the studies did not find a significant association between the temperament traits and the child's BMI ^(12,13). One study found that over a period of time, the weight of children who presented with intense pleasure expression was pretentious ⁽⁹⁾. Another study reported that the lack of attention span in children was a predictor of weight gain; however, this did not manifest to be true regarding girls, because their reactivity to food (those that disliked many types of food) and their low ability to self-calm, were traits that were significantly associated with weight gain ⁽¹⁰⁾.

Another study found association between the child's temperament type and the BMI's increase, but only when sensitivity of the mother was present. A high BMI was found when the child was shy or difficult and had an insensitive mother ⁽⁵⁾. Finally, one of the studies showed that the child's temperament, in conjunction with other variables (ethnicity, gender of the child and parental BMI, parental education, parental age and child age, mother affection and indulgent feeding style), predicted 12% of child's BMI ⁽¹⁵⁾.

Temperament (Self-Regulation)

Four of the studies measured the self-regulation component. In respect to the theoretical support, these studies used the Rothbard concept. This is defined as a self-regulation process based on attention, focus, avoidance, and inhibition, which together seek to inhibit reactivity. Additionally, there are two self-regulation skills. These entail emotional regulation and gratification delay. Emotional regulation can result in reactivity such as anger, complaining, agitation, crying, and tantrums. Emotional

regulation is the effective use of various strategies. A perfect example of Emotional regulation is distraction ^(cited in 9, 11, 16, 17).

Attention control for delayed gratification is associated with two cognitive functions: sustained attention and inhibitory control. Sustained attention refers to the child's ability to maintain his or her attention on specific stimuli. Inhibitory control is the ability to restrain responses that may be inappropriate for a situation ^(cited in 9,11,16,17). Two studies measured the concept of food self-regulation, which is based on the use of internal signals, to help decipher the quantity to be consumed based on various energy needs in everyone ^(10,16).

The measures of self-regulation used were based on observations made in controlled spaces/laboratories. For example, two of the studies measured emotional regulation through two procedures: 1) The child's favorite toy was placed in a closed box and they asked him to wait at least 2 minutes, and 2) They placed the child in a high chair without any toys for 5 minutes (2.7). Through these procedures, the observer measured the time and reactions of these children.

Regarding attentional control and gratification delay, it was measured through two procedures: 1) reward sensitivity, which is the time it took the child to approach and open an attractive wrapped box after they were told that it was a gift for them, and 2) sustained attention, which measured the length of time a child spent watching a 5 minute video without losing their attention ^(9,11).

Another study used different procedures for measuring self-regulation in a child. The interviewer showed the child a "target toy" that was very attractive and allowed them to touch and play with it, all before beginning the "Waiting Game". Once the child had a chance to play with the toy, the interviewer told the child that they were going out to do work in another room. Before they left, they told the child that they were not allowed to touch the target toy until they returned, in the meanwhile, they could continue to play with other toys that were available in the room. The child was left alone with the white toy for 150 seconds ⁽¹⁷⁾.

In that same study, the delay in gratification was measured by showing 3 different foods to the child: M & M sweets, animal crackers, and pretzels. Once the children identified their favorite food, piles of large and small food were placed on a table in front of them. The child could have the small pile of food anytime that they wanted after the interviewer left the room. When the child rang the bell, the interviewer came back, and the child could continue to eat off of the small pile. If the child decided they wanted to eat from the large pile of food, they had to wait until the interviewer came back without the child ringing the bell ⁽¹⁷⁾.

Two studies measured inhibitory control through the CBQ sub-scale effort control with acceptable reliability. In regards to the self-regulation temperament component and infant OW-OB, it was reported that emotional reactivity, shorter response time, and shorter attention span were predictors of increased child BMI over time ^(9,11). Another study of a child found an association between low food self-regulation and a high BMI⁽¹⁶⁾. One study reported that children with low self-regulation and low delay in gratification had a greater BMI gain over time, while those with high self-regulation and high delay in gratification had a smaller BMI gain ⁽¹⁷⁾.

DISCUSSION

The studies found that infant temperament is a variable that seems to have an association with childhood obesity. Of the nine studies reviewed, seven established that these variables are related; nevertheless two of these studies indicated that parental and socioeconomic characteristics, in conjunction with the child temperament, predicted more accurately the infant BMI. This situation might present itself because the child temperament and the environment affects feeding behaviors and consequently, its weight.

Accordingly, it is important to point out that feeding is a biopsychosocial process in which homeostatic mechanisms, neural reward, motor, sensory, and social-emotional capacity are involved ⁽¹⁸⁾. With temperament being a modulator of the processes of activity, emotionality and sociability could generate that a child with difficult temperament will be able to have more predisposition to unhealthy feeding behaviors. This situation can be potentiated for parents, caregivers who provide cultural, social and economic environment, unhealthy choices (sedentary lifestyle, limited access to healthy foods), and indulgent feeding styles. Ultimately, it can result in weight gain in early childhood. Therefore, since OB is a multi-causal and complex problem, it is necessary to consider individual, social, and environmental factors for the better explanation of this health problem ⁽¹⁾.

In the case of those with contradictory results, it is important to consider the measurement instruments that were applied, the construct that they wanted to measure, reliability, and validity. One study reported a review in which it synthesized the literature related to temperament and included temperament concept from different authors, child age, and recommended measuring instruments. Specific criteria must be considered, so the results will present authentic and standardized findings in the preschool population ⁽¹⁹⁾.

Revised literature reports show an association of increased BMI in preschool children regarding the self-regulating temperament component, specifically self-regulation skills such as emotional regulation and gratification delay. This situation could be the result recent research on the study of dietary behavior. This indicates that complex energy regulation processes and reward regulation could be the revealing factors of the individual differences in energy regulation, flavor preferences, and the food-related, reward-seeking behavior ⁽¹⁸⁾. In regards to the limitations to this review, it was not possible to make comparisons between the findings and conclusions. This transpired because different questionnaires or procedures were performed to measure the temperament. Additionally, there was an insufficient amount of articles that included the Hispanic population.

CONCLUSION

The existing literature is still insufficient to establish the relationship between temperament and BMI increase in preschool children. Therefore, it is not possible to be conclusive, since some studies still show contradictory information. It is recommended to continue the research, along with the application of similar criteria for temperament measurement, including attentional reactivity and self-regulation. Furthermore, it is suggested to resume the study of temperament with parental variables, such as feeding styles and psychological characteristics like sensitivity. This suggestion is highly recommended since it appears that when interacting together,

they increase the predictive power of preschool BMI. In finale, we concluded that this study was an opportunity to expand and disseminate the knowledge about temperament and BMI increase in preschoolers. This seems to have a significant and promising impact in the explanation of feeding behaviors being defined as the precursors to childhood obesity.

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