RESUMO
A obesidade é responsável por grande parte dos agravamentos de saúde em especial da população infantil, visto que se encontra relacionada com morbidades do aparelho cardiovascular e sistema de condução de atividades autonômicas cardíacas, que podem ser captadas através de métodos eficazes de análise da variabilidade da frequência cardíaca. Este estudo objetiva analisar a atividade autonômica cardíaca em crianças obesas. Trata-se de uma revisão integrativa realizada através de buscas nas bases de dados LILACS, MEDLINE e IBECS. Foram utilizados os DeCS "frequência cardíaca, sistema nervoso autônomo, criança e obesidade" e operador booleano AND. Foram utilizados os filtros: estudos que apresentassem texto completo e que fossem publicados entre 2014 e 2018; como critérios de inclusão foram estudos originais e nos idiomas português, inglês e espanhol; e, exclusão os duplicados, não serem do público infantil e não se tratar de análise autonômica cardíaca. Uma das principais mudanças na regulação autonômica de crianças é um aumento da modulação simpática com ou sem inibição parassimpática simultânea e uma diminuição da variabilidade cardíaca, quando comparado a crianças eutróficas. Os índices de porcentagem dos intervalos RR adjacentes, o HF em unidades normalizadas apresentaram redução significativa e LF em unidades normalizadas e LF/HF foram maiores no grupo de obesos. Deste modo, evidencia-se que o fator obesidade em crianças não é considerado um precursor, mas como agravante de déficits autonômicos cardíacos; e, que a inserção de programas complementares é capaz de minimizar e/ou reverter danos à atividade autonômica cardíaca.

Palavras chaves: Frequência cardíaca, sistema nervoso autônomo, criança, obesidade.

ABSTRACT
Obesity is responsible for a large part of worsening health condition, especially in the child population, as it is associated with cardiovascular morbidity and the conduction system of cardiac autonomic activity, which can be captured through effective methods of analysis of heart rate variability. This study aims to analyze the cardiac autonomic activity in obese children. This is an integrative review performed through searches in databases MEDLINE, LILACS and IBECS databases. The DeCS used were “heart rate, autonomic nervous system, child and obesity” and the Boolean operator was AND. The filters used were: studies with full text and published between 2014 and 2018; the inclusion criteria were original studies and in Portuguese, English and Spanish; the exclusion criteria were duplicates, not for the child population and not discussing the analysis of autonomic cardiac function. One of the main changes in autonomic regulation of children is an increased sympathetic modulation with or without simultaneous parasympathetic inhibition and a decreased heart rate variability, when compared to eutrophic children. The indexes of percentage of adjacent RR intervals, the HF in normalized units showed significant reduction and LF in normalized units and LF/HF were higher in the obese group. In this way, it is evident that the obesity factor in children is not considered a precursor, but an aggravating factor of cardiac autonomic deficits; and that the insertion of complementary programs is able to minimize and/or reverse damage to cardiac autonomic activity.

Key words: heart rate, autonomic nervous system, child obesity.
INTRODUCTION

Obesity is considered one of the greatest public health problems, because it can lead to and/or worsen various types of pathological conditions. This factor affects not only the adolescent, adult or elderly populations, because there is currently an increase in the index of obese children; estimates show that this will also be a major aggravating factor to the public health system for the next generation, because it has a multifactorial etiology and is influenced by genetic, behavioral and environmental factors.1-2

Individuals who present obesity in childhood phase are likely to develop cardiovascular comorbidities. These include hypertension, considered one of the main health worsening, which is regulated by the autonomic nervous system, which also influences responses to acute or chronic stress by means of autonomic activity.4

One type of change caused by obesity in the body is a modification of the autonomous nervous activity, providing imbalance of vital functions of the organism. One of the methods of analysis of these changes in cardiac autonomic activity is assessing the heart rate variability (HRV), which is constantly performed due to its practicality, for being a non-invasive method able to provide analysis in a selective way.5,6

The HRV is able to quantify the oscillations present in each R-R interval in consecutive heartbeats, as well as successive instant cardiac frequency. Changes in autonomic activities cause imbalance in the most varied types of functions of the body, one of the worrying findings is the reduction of HRV, constituting a risk for sudden death in conditions such as congestive heart failure or after acute myocardial infarction, as well as changes in HRV are taken as valuable and anticipated indicators of commitments inherent to the cardiovascular system.3,6

The exponential growth of children who experience the condition of obesity is alarming, because such a situation directly implies the emergence of morbidities especially of the cardiovascular system and regulation of autonomic nervous system activity, and as described, the expectation is that the number of obese children will dramatically increase. In this way, it is important to establish a synthesis with major changes and injuries to the cardiac autonomic activity that may sensitize the population regarding the prevention of this physical condition that causes harm to the body, especially in children.

Thus, in the midst of the need for analyzing the content above, this study aims to present a review of the literature of studies that assessed the cardiac autonomic activity in obese children.

METHOD

This is an integrative literature review held in October and November 2017 and updated in November 2018, following its design in six steps: Formation of the research question; search in the literature; studies categorization; assessment of included studies; interpretation of results; and, synthesis of knowledge.

For the preparation of the research question “Do obese children present alterations in cardiac autonomic activity?”, the search strategy Population, Variables and Outcomes (PVO) was used, which allowed obtaining the Health Sciences Descriptors (DeCS) appropriate to the theme in question, as described in the table.

Table 01. PVO strategy for the DeCS. Juazeiro do Norte, CE, Brazil, 2018.

<table>
<thead>
<tr>
<th>ACRONYM</th>
<th>COMPONENTS</th>
<th>DeCS</th>
</tr>
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<tbody>
<tr>
<td>Population</td>
<td>Children</td>
<td>Child</td>
</tr>
<tr>
<td>Variables</td>
<td>Obesity</td>
<td>Obesity</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Cardiac autonomic activity</td>
<td>Heart rate; autonomic nervous system</td>
</tr>
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</table>

The search in the literature occurred in the databases Latin American and Caribbean Literature in Health Sciences (LILACS), Medical Literature Analysis and Retrieval System Online (MEDLINE) via the Virtual Health Library (VHL) and Bibliographic Spanish Index in Health Sciences (IBECS - Índice Bibliográfico Español em Ciencias de la Salud). The DeCS were used in association with the Boolean operator AND according to the search strategies described as follows: crossing 01 “Child AND obesity AND cardiac frequency” crossing 02 “child AND obesity AND autonomous nervous system”.

Initially, some filters such as studies with full text available and published in the last five years (2014 through 2018) were used, by presenting results more updated about the theme. The eligibility included original articles, published in Portuguese, English and Spanish; and excluded studies which were repeated between the researched databases, which were not related to the child population, which was classified as under 12 years of age, and those that did not address the study perspective, which was the analysis of cardiac autonomic activity.

The instrument Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) was used to demonstrate more explicitly the search and selection of studies, as in the following figure.

Data were collected and organized through an instrument prepared the authors themselves, in which they were relevant to the characterization phase of studies and synthesis of the main results found. The assessment phase involved a critical analysis based on the findings, favoring the step of interpretation that occurred based on the current literature and dialectic between authors; finally, the synthesis was contemplated with the writing of the manuscript, meeting the proposed goal.

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RESULTS

The searches returned eight articles that synthesized the main findings about the obesity factor on the cardiac autonomic activity. The following table shows the studies included.

<table>
<thead>
<tr>
<th>Study / Year</th>
<th>Objective</th>
<th>Sample</th>
<th>Journal</th>
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<tbody>
<tr>
<td>Mustafa et al, 2017</td>
<td>To evaluate the relationship between erythrocyte membrane fatty acid levels and cardiac autonomic function in obese children using heart rate variability.</td>
<td>32 healthy and 48 obese children</td>
<td>Revista Portuguesa de Cardiologia Portuguese Cardiology Journal</td>
</tr>
<tr>
<td>Cibinello et al., 2017</td>
<td>To compare performance in the six-minute walk test in schoolchildren aged 8 through 10 years, according to nutritional classification, based on two different criteria.</td>
<td>226</td>
<td>Revista Brasileira de Medicina do Esporte Brazilian Journal of Sports Medicine</td>
</tr>
<tr>
<td>Saner et al., 2016</td>
<td>To analyze cardiovascular rhythmicity in obese children.</td>
<td>75 obese and 15 healthy children</td>
<td>European Journal of Pediatrics</td>
</tr>
<tr>
<td>Mazurak et al., 2016</td>
<td>To compare the autonomic regulation in obese and normal weight children and to track the autonomic status during weight reduction.</td>
<td>60 obeses and 27 healthy children</td>
<td>Obesity Research Journal</td>
</tr>
<tr>
<td>Santos-Magalhães et al., 2015</td>
<td>To examine associations between weight status, body fat mass and heart rate variability in prepubertal children, adjusting to physical activity levels.</td>
<td>21 healthy, 08 overweight and 21 obese children</td>
<td>Clinical Anatomic Research</td>
</tr>
<tr>
<td>Tompkins et al., 2015</td>
<td>To examine whether healthy weight and obesity in children engage in moderate to vigorous BP intensity during an unstructured BP program.</td>
<td>12 healthy and 09 obese children</td>
<td>Journal of Physical Activity and Health</td>
</tr>
<tr>
<td>Vanderlei et al., 2014</td>
<td>To analyze the heart rate dynamics in obese children through HRV measurements.</td>
<td>94</td>
<td>Journal of Human Growth and Development</td>
</tr>
<tr>
<td>Vrijkotte et al., 2015</td>
<td>To evaluate the association between activation of the autonomic nervous system and the metabolic profile and its components in children aged 5 through 6 years.</td>
<td>1540</td>
<td>PloS One</td>
</tr>
</tbody>
</table>

Regarding some indicators of variability, the standard deviation of normal RR intervals, the square root of successive differences and the power of high frequency, among others, were found reduced in obese children. Below is a summary of the main findings of the review.
DISCUSSION

Obesity in children is a worrying condition with a high probability of progressively increasing, because there is no scientific evidence pointing to reduced parasympathetic activity, found in this population, as a participant in the modulation of glucose and body fat metabolism, thus having a lower energy expenditure. The exposed shows the importance of homeostasis between sympathetic and parasympathetic activity. A severe reduction of sympathetic indexes can also provide a greater accumulation of adiposity in obese population, by generating a lower energy expenditure, as well as a marked reduction of parasympathetic indexes may be related to most of cardiovascular comorbidities.

The autonomous nervous system, when intact, in its rest state, provides an increased activity of the parasympathetic system. Therefore, individuals with disorders in the conduction of nerve stimuli arising from some acquired or genetic pathological process tend to have a greater sympathetic modulation, often associated with reduced parasympathetic activities.

As seen in the study of Mazurak et al., one of the main changes in children’s autonomic regulation is an increased sympathetic modulation with or without simultaneous parasympathetic inhibition and a decreased HRV, when compared to eutrophic children.

A considerable important factor in obesity is the oxidative stress, since levels of antioxidants, when reduced in the body, can generate significant changes in physiological functions such as the autonomic nervous system, since these substances are inversely related to cardiovascular risk factors.

The studies of Ryder et al. assessed the autonomic activity in children with arterial hypertension, showing that these had lower values for their analysis HRV indices regardless of the presence of adiposity factor or not.

The obesity factor is strongly related to the development of hypertension in adolescents, adults and elders. This perspective of correlation is not so efficient when considering the child population, as demonstrated in a previous study. Studies that analyze the autonomic activity in children investigate changes in the indices of low frequency (LF) and high frequency (HF) as a reflection of the balance of the autonomic nervous system. The increased LF/HF ratio is a factor present in obese children.

The search of Freitas et al. analyzed cardiac autonomic dysfunctions in normotensive obese children, finding that indexes such as LF and HF in absolute units, standard deviation of all normal RR intervals and the square root of the average square of differences between adjacent normal RR intervals, showed no significant differences between the obese and non-obese groups. The indexes of percentage of adjacent RR intervals with difference of duration greater than 50 milliseconds and HF in normalized units showed significant reduction and LF in normalized units and LF/HF were higher in the obese group.

Evidences indicate that obese children have extensive and standardized abnormalities, thus allowing a further analysis of abnormalities related to the pathogenesis of autonomic nervous system, noting decreased parasympathetic activity as body weight increases.

An important finding is that the obesity factor is taken as an aggravating, but not determinant, factor of cardiac autonomic changes, because the analysis of the present studies showed that obese children do not have unanimous damage to autonomic activity.

Damages inherent to the cardiac autonomic activity are more directly associated to sedentary lifestyle than to the obesity factor. As analysis of Baum et al., there were decreases in autonomic activities of obese and physically inactive children, unlike active obese children.

The reduction of risks by means of complementary methods is essential in the process of combating the changes.
caused to the modulation rate. The research of Ricci-Vitor et al. analyzed the insertion of physical exercises associated with nutritional and psychological guidance, demonstrating that the insertion of these practices is able to promote benefits on the cardiac autonomic modulation of obese children.

In relation to the analyzed indicators, Ricci-Vitor et al. verify that there was a reduction of parameters such as heart rate at rest and transfer of classification of children classified as obese to overweight children. Changes also occurred in the parasympathetic activity, in which it showed an increase of its indices after implementing the proposed program and, in the qualitative analysis of the Plot of Poincaré, which suggested that the program promoted increase in HRV and, consequently, an improvement of autonomic modulation.

FINAL THOUGHTS

Children classified as obese present some major changes such as increased LF and LF/HF indexes, as well as a possible reduction in HF index, representing an increase of sympathetic activity with or without the presence of inhibition of the parasympathetic activity.

Obesity is considered a predictor of changes in autonomic nervous system activity in adolescents, adults and elders. Evidences showed that, in children, this factor is not considered a predictor, but a worsening, demonstrating that the inclusion of complementary programs such as the practice of physical exercises are able to minimize and/or reverse damage to cardiac autonomic activity.

REFERENCES


