

**Sedentary behavior in children and adolescents with autism spectrum disorder:
integrative review****Comportamento sedentário em crianças e adolescentes com transtorno do espectro
autista: revisão integrativa****Comportamiento sedentario en niños y adolescentes con trastorno del espectro autista:
una revisión integradora**

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Objective: to identify and compare evidence in publications on sedentary behavior and physical activity related to children and adolescents with Autism Spectrum Disorder and those with typical development. **Methods:** integrative review whose guiding question was: “*Are children and adolescents with autism spectrum disorder more sedentary than children and adolescents with typical development?*” The searches were carried out in the following databases: Virtual Health Library, Medical Literature Analysis and Retrieval System On-line, EMBASE and Cochrane Library. **Results:** 10 articles written in the English were selected. Publications have shown that younger autistic children are more physically active than adolescents and older children, who spend more time in sedentary behavior. **Conclusion:** autistic children and adolescents are generally less physically active and spend more time on screen activities compared to typically developing children.

Descriptors: Autism Spectrum Disorder; Sedentary behavior; Child; Adolescent.

Objetivo: identificar e comparar as evidências em publicações sobre comportamento sedentário e prática de atividade física relacionadas às crianças e adolescentes com Transtorno do Espectro Autista e aqueles com desenvolvimento típico. **Método:** revisão integrativa que teve como pergunta norteadora: “*Crianças e adolescentes com transtorno do espectro autista são mais sedentárias do que as crianças e adolescentes com desenvolvimento típico?*”. As buscas foram realizadas nas bases de dados: Biblioteca Virtual em Saúde, *Medical Literature Analysis and Retrieval System On-line*, EMBASE e Cochrane Library. **Resultados:** Foram selecionados 10 artigos do idioma inglês. As publicações mostraram que crianças autistas mais novas são mais ativas fisicamente do que os adolescentes e crianças mais velhas, que passam um maior tempo em comportamento sedentário. **Conclusão:** Crianças e adolescentes autistas geralmente são menos ativas fisicamente e passam mais tempo em atividades de tela se comparadas às crianças com desenvolvimento típico.

Descritores: Transtorno do Espectro Autista; Comportamento sedentário; Criança; Adolescente.

Objetivo: identificar y comparar evidencias en publicaciones sobre comportamiento sedentario y actividad física relacionadas con niños y adolescentes con Trastorno del Espectro Autista y aquellos con desarrollo típico. **Método:** revisión integradora cuya pregunta guía fue: “*¿Son los niños y adolescentes con trastorno del espectro autista más sedentarios que los niños y adolescentes con desarrollo típico?*”. Las búsquedas se realizaron en las siguientes bases de datos: Biblioteca Virtual de Salud, *Medical Literature Analysis and Retrieval System On-line*, EMBASE e *Cochrane Library*. **Resultados:** Se seleccionaron 10 artículos en inglés. Las publicaciones mostraron que los niños autistas más pequeños son más activos físicamente que los adolescentes y los niños mayores, que pasan más tiempo en conductas sedentarias. **Conclusión:** En general, los niños y adolescentes autistas son menos activos físicamente y pasan más tiempo en actividades de pantalla en comparación con los niños con un desarrollo típico.

Descriptorios: Trastorno del Espectro Autista; Conducta sedentaria; Niño; Adolescente.

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INTRODUCTION

Autism, or Autism Spectrum Disorder (ASD) is defined as a group composed of manifestations such as problems in communication, social interaction, language and stereotypical behavior, which is represented by repetitive, selective and restrictive patterns of behaviors, activities and interests¹.

The etiology and pathogenesis of this disorder are still unknown. Evidence suggests that autism is a consequence of a combination of environmental and genetic factors. Environmental factors include nutritional factors, socioeconomic factors (including lifestyle), exposure to heavy metals, air pollution and social behaviors². Among the genetic factors, there is a change in gene expression, progressing to a failure in neural connection, brain development and morphology between dendritic endings in the synapse³.

Regarding the epidemiology of ASD, it is estimated that worldwide, one in every 160 children has autism spectrum disorder. This estimate represents an average value and prevalence appears to be increasing globally. There are possible explanations for this increase, including increased awareness of the topic, expanded diagnostic criteria, better tools and improved information reported⁴.

Autistic children and adolescents possibly have higher levels of sedentary behavior, as the presence of repetitive and restrictive action can impact motor skills and physical fitness levels, leading to a low level of daily physical activity. Therefore, resulting in a high incidence of overweight, obesity and associated problems⁵.

All over the world, few children and adolescents perform at least 60 minutes of physical exercise with moderate to vigorous intensity a day, as it is recommended. Thus, high levels of sedentary behaviors and physical inactivity can negatively affect health in the short, medium and long term⁶.

Considering this scenario, the following question arose: *Are children and adolescents with autism spectrum disorder more sedentary than children and adolescents with typical development?* Thus, this study aims to identify and compare evidence in publications on sedentary behavior and physical activity related to children and adolescents with Autism Spectrum Disorder and those with typical development.

METHODS

This study is an integrative review, with a search considering the terms that characterize the research question structured by the PICO method: population, phenomenon of interest and context (Chart 1). The work was carried out through database research, based on pre-defined

inclusion and exclusion criteria aiming at the quality of the studies, their proximity to the theme and following the steps of the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA).

The search strategy was carried out in the Virtual Health Library (VHL), Medical Literature Analysis and Retrieval System On-line (MEDLINE) via PubMed, EMBASE via Elsevier and Cochrane Library databases in May 2022. Indexed descriptors from Medical Subject Headings (MeSH), Health Sciences Descriptors (DeCS) and Emtree were used, namely: "Autistic Disorder", "Autism Spectrum Disorder", "Sedentary Behavior" and similar.

Chart 1. Acronym for the population method, phenomenon of interest and context.

Population	Children and adolescents on the Autism Spectrum Disorder/typical development
Phenomenon of interest	Sedentary behavior
Context	Physical activities

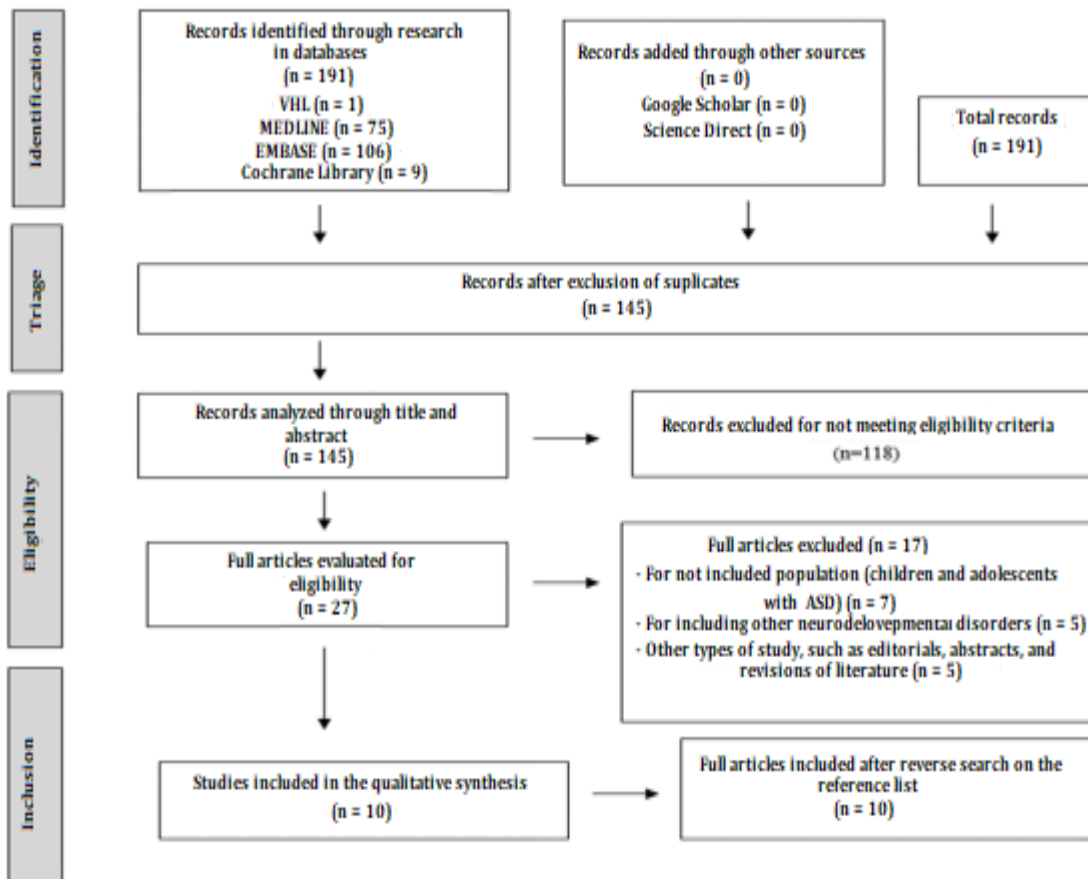
Subsequently, the full text filter was used in the databases and the articles were exported to Intelligent Systematic Review – Rayyan. In Rayyan, the filter was used to exclude duplicates and the articles were pre-selected by reading their titles, abstracts and analyzing the inclusion and exclusion criteria blindly by two independent reviewers.

The inclusion criteria for the research were used: articles that deal with sedentary behavior and levels of physical activity in autistic children and adolescents, articles available in full, without language or year restrictions. As exclusion criteria: studies that deal with sedentary behavior and levels of physical activity in autistic adults and elderly people or that involve other intellectual disabilities, abstracts, book chapters, course conclusion works, dissertations, theses, event annals and reviews.

RESULTS

The study considered 10 articles, after selection according to Figure 1:

Figure 1. Flowchart of selection of studies for review. Mossoró/RN, Brazil, 2023.



According to Table 2, the studies were analyzed and compiled, regarding authorship, year of publication, objectives, methods, sample size and main findings.

Table 2. Main points covered in the included studies. Mossoró/RN, Brazil, 2023.

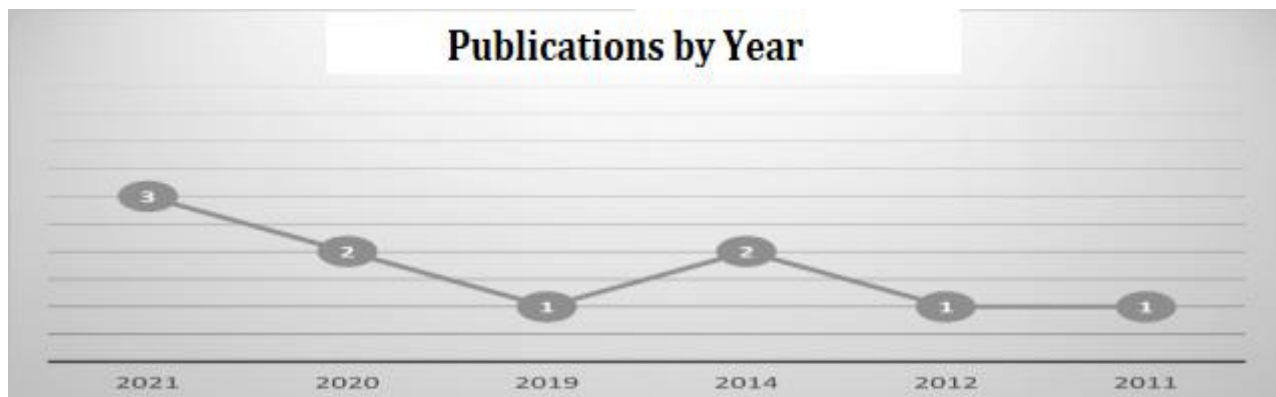
Author/year	Objective	Methods	N	Main findings
Menear KS; Ernest JM, 2020.	To analyze data from the National Survey of Children's Health (2016–2017), comparing physical activity and screen time of children with and without autism by age and level of ASD severity.	The study employed chi-square analyzes of 2016–2017 NSCH data to compare physical activity, TV/video/game time, and portable electronic device use by children with and without autism by age and disorder severity.	71.811	As children grew older, the amount of physical activity they performed decreased. Autistic children spent more time on screens than typically developing children, and they did not perform 60 minutes of physical activity during the last week compared to children without autism.
Healy S. <i>et al.</i> , 2020.	To examine the composition of 24 hour movement behaviors in children with autism using objective measures and to use compositional analysis to examine the associations of time spent in light physical activity, sedentary behavior, sleep, and moderate-vigorous physical activity with BMI.	To collect data, a sociodemographic questionnaire was used, answered by the children's guardians and their weight and height were measured. To evaluate participants' movement behaviors, ActiGraph GT9X accelerometers were used for 7 days.	46	Participants spent 40% of their time in light physical activity (9.6 h), 30.6% (7.34 h) in sedentary behavior, 24.9% (5.98 h) sleeping, and 4.5% (64 h 8 min) in moderate-vigorous physical activity. The sample had insufficient sleep (average of 6 h/night). Insufficient sleep has been linked to increased BMI
Moludi J. <i>et al.</i> , 2019.	Compare macro and micronutrient intake and physical activity patterns between boys with and without autism.	Participants' weight and height were measured. The individuals' food intake was measured using a Food Consumption Frequency Questionnaire. The level of physical activity was recorded for 7 days using an ActiGraph GTX3 accelerometer.	59	The level of moderate physical activity was lower in autistic children than in children without the disorder, while sedentary behavior was higher in autistic children. Comparison of micronutrient intake in autistic children with the recommended dietary intake (RDI) revealed that the intake of calcium, magnesium, vitamin C and vitamin D is below the required amounts.
MacDonald M. <i>et al.</i> , 2011.	To describe the sedentary and moderate-to-vigorous physical activity patterns of children aged 9 to 18 years with autism spectrum disorder as they grow.	Physical activity was measured using the Actical™ accelerometer over 7 days and prior to the adapted physical activity intervention. As psychometric measures, 2 vocabulary and matrix reasoning subtests were used, in addition to the WASI. The SRS questionnaire (measuring autistic traits) was completed by those responsible. Participants' weight, height, triceps	72	Older children with autism are significantly more physically inactive compared to younger children. Based on current guidelines, all age groups are meeting the minimum recommendation of 60 minutes of moderate to vigorous physical activity daily. Although, it is known that most of this time is spent in moderate, non-vigorous physical activity. At the same time, 43% of the

		skinfold thickness and calf skinfold thickness were measured.		children in this study are overweight.
Must A. <i>et al.</i> , 2014.	Evaluate and compare measures of sedentary behavior in children with typical development and children with autism. Relating sedentary behavior and excess weight among children with autism spectrum disorder.	For data collection, questionnaires on physical activity and sedentary behavior were used, answered by the children's guardians and their weight and height were measured.	111	Television time, computer time, and total screen time were significantly higher in autistic children compared to children without autism. A significant but modest association between BMI z-score and total weekend sedentary behavior and screen time was identified only in children with autism, suggesting that sedentary behavior is linked to relative overweight in these children.
Memari AH. <i>et al.</i> , 2012.	To examine physical activity patterns in children and adolescents with autism, as well as address the determining factors of physical activity, using triaxial accelerometry.	To collect data, a sociodemographic questionnaire was used with questions about health answered by those responsible and the weight and height of the participants were measured. To evaluate participants' movement behaviors, ActiGraph GT3X accelerometers were used for 7 days.	80	There was a substantial reduction in physical activity throughout adolescence in autism. Girls were significantly less active than boys with autism spectrum disorder. Participants were notably less active at school compared to after school.
Pan CY. <i>et al.</i> , 2021.	To compare the physical activity and sedentary patterns of young Taiwanese males with autism at different school levels and on weekdays and weekend days.	To collect data, a questionnaire on sedentary behavior was used, answered by the participants and their weight and height were measured. To assess participants' physical activity levels, ActiGraph GT1M accelerometers were used for 7 days.	68	Young people with autism spectrum disorder have lower levels of physical activity and greater screen time and sedentary lifestyle as they grow up. Most elementary school youth with autism exceeded screen media use guidelines but were physically active on weekdays and weekends. Most high school youth with ASD did not meet physical activity recommendations and spent more time on screen media on weekend days.
Sung YS. <i>et al.</i> , 2021.	To examine differences in physical activity and motor performance between young children with autism spectrum disorder and children with typical development and to investigate relationships between physical activity levels	To examine the severity of autism, a CARS-2 score was determined by a professional. Participants were instructed to wear ActiGraph wGT3X-BT accelerometers on their non-dominant wrist for 1 day a week (24 h). All participants were assessed by registered occupational therapists using the Movement Assessment	53	Young children with autism spent significantly less time in moderate and light physical activity and exhibited more sedentary behavior than typically developing children. Children with autism spectrum disorder also had greater motor difficulties and were less frequently involved in physical recreation activities

	and motor performance.	Battery for Children and Participation Assessment for Preschool Children.		compared to children without the disorder.
Nguyen TD. <i>et al.</i> , 2021.	To evaluate sleep characteristics and the effect of physical activity level on sleep quality in boys with autism compared to typical development.	To collect data, a sociodemographic questionnaire (age, weight and height), a child's sleep diary, a sleep habits questionnaire (CSHQ) and a physical activity questionnaire for children (PAQ-C) were used to collect data. by the participants. To assess participants' physical activity levels, accelerometers were used for 5 days.	68	Some significant differences were reported between groups. Resistance to awakening was significantly higher ($p < 0.05$) in autistic individuals. However, they also had poor sleep quality. The total time for physical activity and the number of daily steps were significantly lower in the group with autism ($p < 0.05$). The time for sedentary behavior was significantly longer ($p < 0.01$) in the group with autism spectrum disorder.
Tyler K. <i>et al.</i> , 2014.	Examining the physical activity and fitness of school-aged children (9-18 years) with autism compared to typically developing children.	To collect data, a sociodemographic questionnaire was used, answered by the children's guardians, the participants' weight and height were measured, as well as diagnostic and developmental assessments and a series of physical fitness assessments: 20-meter multi-stage transport, sit-and-reach test and handgrip strength. To assess participants' physical activity levels, ActiGraph GTX3+ accelerometers were used for 7 days.	29	It was observed that autistic children are less physically fit in the strength domain and less physically active (they spent less time in light, moderate and moderate to vigorous physical activities and spent more time in sedentary behavior) than their peers without autism. Physical fitness in flexibility, aerobic fitness and BMI demonstrate similar results in both groups.

The articles selected in their entirety are written in English and were published between 2011 and 2021, according to the graph below (Graph 1).

Graph 1. Year of publication. Mossoró/RN, Brazil, 2023.



All studies had a quantitative approach. Chart 3 highlights the characteristics of the work regarding the type of study, country, sex and age group of the participants. The number of participants involved in the research varied from 29 to 71,811 individuals. Among the ten studies, three used only male children or adolescents with Autism Spectrum Disorder as a sample. Studies generally included participants in more than one age group, ranging from 0 to 18 years old, some of preschool, primary school, and secondary school age. Regarding the location of the included studies, half of the studies were carried out in the United States.

Chart 3. Characteristics of studies. Mossoró/RN, Brazil, 2023.

Author, year	Type of study	Country	Sex	Age group
Menear KS; Ernest JM, 2020.	Documentary	USA	Both	0-17 years
Healy S. <i>et al.</i> , 2020.	Cross-sectional	USA	Both	7- 19 years
Moludi J. <i>et al.</i> , 2019.	Case-control	Iran	Male	6-13 years
MacDonald M. <i>et al.</i> , 2011.	Cross-sectional	USA	Both	9-18 years
Must A. <i>et al.</i> , 2014.	Cross-sectional	USA	Both	3-11 years
Memari AH. <i>et al.</i> , 2012.	Cross-sectional	Iran	Both	7-14 years
Pan CY. <i>et al.</i> , 2021.	Cross-sectional	Taiwan	Male	6-17 years
Sung YS. <i>et al.</i> , 2021.	Cross-sectional	Taiwan	Both	4-6 years
Nguyen TD. <i>et al.</i> , 2021.	Cross-sectional	Finland	Male	7-17 years
Tyler K. <i>et al.</i> , 2014.	Cross-sectional	USA	Both	9-18 years

Among the instruments for data collection we can mention: sociodemographic questionnaires, anthropometry (measurement of weight, height, triceps skinfold and calf skinfold), use of accelerometers, food consumption frequency questionnaire, psychometric tests of vocabulary and reasoning matrix, questionnaire to measure autistic traits, questionnaires on physical activity levels, child's sleep diary, sleep habits questionnaire (CSHQ), in addition to physical fitness tests. The most used instruments were sociodemographic questionnaires, accelerometers and weight and height measurements.

DISCUSSION

In the evidence found on sedentary behavior and physical activity related to children and adolescents with Autism Spectrum Disorder, the following stood out: children and adolescents with autism spend more time in sedentary behavior (they are less physically active and have more screen time) compared to children with typical development.

Younger autistic children are more physically active than adolescents and older children^{7,8,9,10}. Female autistic children were significantly less active than male children. Participants were notably less active at school compared to after school¹⁰. Thus, physical activity levels vary according to the gender and age group of this audience.

Children with ASD had greater motor difficulties and were less frequently involved in physical recreation activities compared to children without the disorder¹¹. They are also less physically capable in terms of strength¹².

Regarding the food consumption of autistic boys, a study revealed that the intake of calcium, magnesium, vitamin C and vitamin D is below the necessary amounts¹³. Considering the Body Mass Index (BMI), some studies showed that autistic children had a higher BMI compared to the group without autism^{8,14}, on the other hand, another study demonstrated similar results in both groups¹².

With regard to sleep, one of the studies shows that autistic children sleep an average of six hours a night, thus having insufficient hours of sleep¹⁵. Another study shows that autistic children were more resistant to waking up, but had poor sleep quality¹⁶.

The articles included in this study were published between the years 2011 and 2021, showing that research with the public who have Autism Spectrum Disorder is growing and thus increasing the general population's awareness of the topic.

Three studies analyzed in this research used only male children or adolescents as samples. This can be explained by the higher prevalence of males with the disorder, as previous studies report in epidemiological research on autism, an average of 3.5 to 4 boys for every 1 girl with the disorder^{6,17,18,19}.

Accelerometers were one of the most used instruments for data collection, and are currently considered a gold standard technique, as accelerometry makes it possible to quantify the frequency, duration and intensity of activity depending on the properties of acceleration indicators, such as the oscillation pattern, the time interval and their magnitude. Therefore, data collected with accelerometers reveals more reproducibility and validity than self-report instruments^{20,21,22}.

Other instruments widely used for collection were anthropometric indicators (weight and height) in the assessment of nutritional status, with anthropometry being the most appropriate and viable tool to be adopted, as it indicates low cost, easy implementation, easy application, standardization, range of the aspects analyzed, in addition to being non-invasive²³.

The results of the present study corroborate other research, in which autistic children and adolescents are less physically active and spend more time in sedentary behaviors. Thus, sociodemographic and clinical factors and in particular the use of smartphones, tablets and/or computers contributed to the sedentary lifestyle in this population⁶.

It was found that younger autistic children are more physically active than older children and adolescents, that is, as age increases, the level of physical activity decreases. Consequently,

physical activity interventions for autistic children must be carried out from the first years of life to change habits and avoid an increase in sedentary behaviors as they age.

In light of this, McCoy and Morgan²⁴ found that autistic children and adolescents aged 10 to 17 years were less likely to perform 60 minutes of physical activity as the severity of the diagnosis increased. Likewise, the study by Ratclif K. *et al.*²⁵, also noted that autistic children between 6 and 7 years old showed significantly lower levels of involvement in physical, recreational, social, skill and task activities than children with typical development.

Therefore, in a study carried out in the city of Fortaleza/Ceará, Brazil, it was observed that more than 60% of the autistic children and adolescents studied did not perform physical activity, being considered sedentary, indicating that the greatest difficulty for this practice is the lack of time guardians for children and other factors such as financial issues for teenagers⁶.

According to Young²⁶, children with autism, in addition to presenting disorders in social interaction, motor function, and cognition, also practiced little physical activity, which could result in childhood overweight and obesity.

The need for attention for this group regarding nutrition is visible. Therefore, nutritional status is influenced by lifestyle habits. The use of medication, a sedentary lifestyle and intestinal issues, common in children and adolescents with autism, are associated with excess weight, significantly compromising the quality of life and health of autistic individuals²⁷.

Regarding nutrient consumption, one of the studies analyzed indicated that autistic boys had a low intake of calcium, magnesium, vitamin C and vitamin D¹³. Won H, *et al.*²⁸, also report calcium and magnesium deficiencies in this population and indicate that peculiarities in eating behavior generate negative consequences on the nutritional status and growth of this population.

Therefore, greater caution must be taken regarding the food consumption of these children so that it does not become monotonous and poor in nutrients. Furthermore, improving food intake, along with an adequate and healthy diet, results in positive impacts on nutritional status, development and symptoms typical of Autism Spectrum Disorder²⁹.

Considering the Body Mass Index (BMI), there was no consensus among studies, some showed that autistic children had a higher BMI compared to the group without autism, on the other hand, other studies demonstrated similar results in both groups. A study carried out in the state of Maranhão, Brazil, indicated that 69% of children with Autism Spectrum Disorder showed food selectivity and more than half (55.2%) of autistic children were overweight²⁹. Caetano and Gurgel¹⁷ also found high percentages of excess weight in autistic children from

Limoeiro do Norte-CE, Brazil, aged 3 to 10 years, with 23.1% being overweight and 15.38% being obese.

With regard to sleep, one of the selected articles pointed out that autistic children had insufficient hours of sleep¹⁵ and another study highlights that autistic children were more resistant to waking up, however, they also had poor sleep quality¹⁶. Also, physical activity is related to sleep in children with Autism Spectrum Disorder, so sedentary behaviors or excessive physical activity can harm the quality of sleep in this population¹⁶.

Thus, in a study carried out with adolescents from the Brazilian Northeastern region, it was noted that the prevalence of insufficient sleep duration was high, and adolescents who reported excessive screen time were more likely to have insufficient sleep duration³⁰. Thus, showing that teenagers with typical development are already extremely attracted to screens and the autistic public has an even greater tendency to this attraction, with their sleep quality being impaired.

CONCLUSION

The productions considered that autistic children and adolescents are less physically active and spend more time on screen activities compared to children with typical development, that is, they show greater sedentary behavior. Also, the younger children are more active.

Some limitations were observed, as some research was based on reports from those responsible for children or adolescents, which may be subject to memory bias and/or reporting errors. Furthermore, regarding the association between sedentary time and BMI z-score, the cross-sectional nature of the studies makes it impossible to separate temporally between exposure and outcome.

Seasonal variability together with the wide age range may have contributed to the different findings. The sample size and the use of accelerometers for a short time were also mentioned, as they were supposed to measure physical activity over a longer period of time.

The data show the need for managers and health professionals to outline strategies to promote health and quality of life for the autistic population and their families. Therefore, considering the complexity of Autism Spectrum Disorder, it is suggested that new studies be carried out discussing this topic, adding a greater scientific and methodological apparatus.

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