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A Comparison of Activity Participation between Children with and without Asthma

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A Comparison of Activity Participation between Children with and without Asthma

Abstract

Background: Asthma affects approximately 6 million children in the United States and can greatly impact quality of life and occupational engagement. Although occupational therapists are well-equipped to address participation limitations, insufficient evidence exists to support the role of occupational therapists in asthma treatment.

Method: The purpose of this study was to further understand the occupational limitations experienced by children with asthma. We also explored a dual diagnosis of asthma and obesity. The participants included children with (n = 84) and without (n = 63) asthma living in New York City. The Child Behavior Checklist, Youth Self Report, Brief Respiratory Questionnaire, and accelerometer data were used to examine occupational participation.

Results: Although accelerometry data demonstrated that children with asthma were equally as active as their non-asthmatic peers, the participants with asthma perceived themselves as participating more in sedentary occupations and were less likely to be members of sports teams. They also had more missed school days and nights of troubled sleep. The children with both asthma and obesity reported the highest level of activity limitations.

Conclusion: This study illustrates specific limitations experienced by children with asthma and supports the need for occupational therapy intervention. Future studies are needed to design and assess interventions that will support the addition of occupational therapists to multidisciplinary asthma treatment teams.

Comments

The authors declare no conflicts of interest.

Keywords

asthma, obesity, occupational therapy, pediatrics

Cover Page Footnote

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Credentials Display

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Asthma is a chronic inflammatory disease of the airways affecting 1 out of every 12 children in the United States (Centers for Disease Control and Prevention, 2019). Prevalence of asthma is closer to 1:7 to 1:8 among African American and Latino children (Zahran et al., 2018). Children with asthma often experience symptoms of coughing, wheezing, chest tightness, and shortness of breath, which can greatly reduce quality of life for both children and caregivers (Global Initiative for Asthma, 2020; Sheikh et al., 2017; Zahran et al., 2018). Asthma can result in great difficulty carrying out the basic daily life activities of childhood, including play, sleep, and school attendance. Up to 86% of children with asthma maintain the diagnosis and activity limitations into adulthood, placing a significant burden on society via the health care and education systems (Tai et al., 2014). Children who experience activity limitations because of their asthma are twice as likely to be overweight or obese (Holderness et al., 2017). A cyclical relationship exists between these diseases: among children with asthma, poor symptom control can impede normal activity and lead to obesity, which can further increase symptoms and worsen control (Forno & Celedon, 2017; Holderness et al., 2017).

There has been great focus on reporting asthma morbidity data with regard to the frequency of hospitalizations and emergency department visits and little focus on examining daily living limitations resulting from the disease (Holder-Niles et al., 2017; Kaur et al., 2015). Sleep impairments, school absences, and, more recently, generalized time spent engaging in varied levels of physical activity have been reported, but there have been little data gathered with respect to other specific daily activities (Cassim et al., 2016).

Children with asthma experience lower sleep efficiency as compared to their healthy peers (Martin et al., 2017). Sleep disruptions resulting from nighttime asthma symptoms can result in daytime drowsiness limiting activity, including school attendance; these associations are heightened by poor sleep hygiene, which is more common among urban children and families (Koinis-Mitchell et al., 2015). Even for many children with well-controlled asthma, there is evidence of poor sleep quality (Sheen et al., 2017). Seven million school days lost each year can be attributed to symptoms of asthma, making it a leading cause of school absenteeism (Cicutto et al., 2014; Hollenbach & Cloutier, 2014; Sullivan et al., 2018a). While there was previously conflicting evidence, recent reports demonstrate that absenteeism secondary to asthma negatively impacts children's academic performance (Liptzin et al., 2016; Nilsson et al., 2018). School absences result in shifting childcare responsibilities, and caregivers of children with asthma miss up to 1.8 times as many workdays as caregivers of children who do not have asthma, placing a significant financial burden on their families (Sullivan et al., 2018b).

Missed school days and the inability to participate during recess, physical education, and extracurricular activities make it difficult for children to engage in interactive play with peers (Bhagat et al., 2018). As a result of their illness and related participation limitations, children with asthma have a higher psychosocial burden and are at greater risk for bullying, exclusion from peer activities, and social difficulties (Gibson-Young et al., 2014; Lahaye et al., 2014). Moreover, children feel embarrassed about their asthma status, medications, breathlessness, and activity restrictions; many worry about disclosing their condition to friends for fear of being teased; and children with asthma report less satisfactory relationships with peers (Rhee et al., 2017; Walker & Reznik, 2014).

According to the Global Initiative for Asthma (GINA), a main goal of asthma management in children is to maintain normal play and activity participation because of the importance of engagement for a child's physical and social development (2020). Unfortunately, many primary care physicians have been slow to adopt the guidelines for management of asthma and fail to take activity participation into

account, often underestimating activity limitations and their impact on quality of life (Cloutier, 2016; Sheikh et al., 2017). As a result, this therapeutic goal is not being met. Many children with asthma and their caregivers, particularly among minority and low-income families, are forced to self-manage by placing limits on participation and neglecting some activities of daily living (Bellin et al., 2017; Jonsson et al., 2014).

Occupational therapists, uniquely trained in the skill of activity analysis and grading, are well-equipped to analyze children's occupational participation as it is impacted by asthma. Therapists' expert ability to grade and adapt daily activities to promote optimal function supports a role for occupational therapists as members of multidisciplinary asthma care teams. However, in order to work as part of a multidisciplinary pediatric asthma treatment team, occupational therapists must first expand their knowledge of asthma, including an understanding of the effects of the disease on daily activities, to provide interventions that will support a child's needs.

While there have been a large number of studies regarding pediatric asthma, such studies have primarily been conducted outside of the field of occupational therapy. One study in the profession surveyed occupational therapists' knowledge of asthma and attitudes toward treatment and found that most respondents supported a role for occupational therapists in the treatment of asthma. However, these same respondents also expressed a lack of knowledge regarding the impact of asthma on daily life and confusion about the role occupational therapists could play in treatment (Lorenzo & Metz, 2013).

Previous publications from our group and others have investigated activity using only accelerometry data and have demonstrated that the amount of time spent engaged in varied levels of physical activity does not differ by asthma status (Lovinsky-Desir et al., 2016). However, in the profession of occupational therapy, participation must be defined and measured by more than time alone. To our knowledge, the present study is the first to examine children with asthma from an occupational perspective. Here, we rationalized that an exploration into differences in patterns of engagement in specific occupations between children with and without asthma warranted further assessment. Therefore, the purpose of this study was to compare the occupational participation of children with and without asthma to understand how the disease may impact children's activity participation and support the addition of occupational therapists to multidisciplinary treatment teams. This understanding is needed to allow therapists to address potential occupational injustices experienced by children with asthma by designing asthma-specific occupational therapy interventions that will enable children to participate optimally in desired daily activities.

This study focused on a small cohort of children aged 9–14 years and living in New York City. A quantitative approach was used to examine differences in occupational participation between children with a diagnosis of asthma and those without. Specifically, we asked the following primary research questions: Do children with asthma participate less in physical activities and more in sedentary occupations, than their non-asthmatic peers? Do sleep and school attendance differ between children with and without asthma in our cohort? Do children with asthma participate less with others, and more alone, than their non-asthmatic peers? Our secondary research objective explored how having a dual diagnosis of both asthma and obesity further impacted occupational engagement.

Method

Research Design

A cross-sectional design was used to compare the occupational participation of children with and without a diagnosis of asthma living in New York City. A two-group, case-control design with no

randomization was used. The study was approved by the Columbia University Institutional Review Board. Written consents and assents were obtained from the parents and participants, respectively.

Participants

Study participants were recruited from the parent Columbia Center for Children's Environmental Health birth cohort (Donohue et al., 2013; Perera et al., 2002). For the purposes of this nested case-control study, cohort participants were recruited based on an evaluation for current asthma. This included the presence or absence of a physician diagnosis (target 56% with asthma) and report of asthma symptoms or use of asthma medications in the 12 months leading up to enrollment, as previously described (Jung et al., 2017; Lovinsky-Desir et al., 2014). To be included in the study, participants had to be between 9–14 years of age and live in one of the five boroughs of New York City. This age group was selected because the presence of asthma during middle childhood is highly predictive of persistent adulthood asthma (Wang et al., 2019). Parent study participants were excluded if they did not complete all components of the present nested study within 18 months.

Instruments

Child Behavior Checklist and Youth Self Report

The Child Behavior Checklist (CBCL) and Youth Self Report (YSR) were developed to identify and assess patterns of adaptive and maladaptive functioning (Achenbach & Rescorla, 2001). These assessments were of particular relevance to this study, as they gather information with respect to both perceived amount of time participants engage in various personally meaningful occupations, as well as perceived confidence level in abilities. This information provided a robust occupational profile for each participant. Both questionnaires collect the same information, but the CBCL is completed by the child's caregiver while the YSR is written in the first person and completed by the adolescent themselves. The CBCL has been validated for use with children 6–18 years of age and the YSR for adolescents 11–18 years of age. For the purposes of the parent study, the YSR was introduced at the first clinic visit after the child aged into the range for which the YSR has been validated.

Administration time for both assessments is 15–20 min. This study used the data obtained in the first social, activity, and academic competence portion of the assessments. Twenty questions gather information related to specific activities, hobbies, and relationships. For each item, respondents report their perceived (a) abilities and (b) level of participation, as compared to peers, using a 3-point Likert scale (0 = *below average*, 1 = *average*, 2 = *above average*). For the purposes of this nested study, the results of the second portion of the assessment, in which participants rate 118 behavioral prompts using a similar 3-point Likert scale, were not analyzed. Internal consistency was reported by Achenbach and Rescorla (2001) to be moderate to high, with Cronbach's alpha values ranging from .63–.97 on the CBCL and .55–.95 on the YSR.

Brief Respiratory Questionnaire

The Brief Respiratory Questionnaire (BRQ) is a self-report measure that requires less than 5 min to complete (Bonner et al., 2006). The BRQ was used to gather information from the caregiver regarding their child's respiratory symptoms, interrupted sleep patterns, and missed school. For each of the 15 questions, the respondents either answer yes or no or indicate a number of days, months, or times that a specific event occurred in the last 12 months. Bonner et al. (2006) found good agreement between results of the BRQ and physician-reviewed validation interviews, reporting a .73 Kappa coefficient value.

Accelerometer

The participants were required to wear an accelerometer, the Actical (Philips Respironics, n.d.), for 6 days to collect data regarding activity expenditure. The Actical device has an internal sensor that monitors frequency and intensity of movement. From this information a participant's energy expenditure throughout the day can be calculated. The accelerometer is able to provide data on the amount of time the wearer spends in sedentary, light, moderate, and vigorous levels of physical activity. Actical measurements have been previously reported to correlate significantly with activity energy expenditure results obtained in an exercise laboratory (r = .85), demonstrating that the Actical provides valid measurements of energy expenditure and physical activity (Puyau et al., 2004).

Procedures

The study personnel made home visits to issue an Actical to the participants. At this visit, anthropometric measures were collected. The children's weight and height were measured and were used in combination with gender and age to calculate the participants' BMI z-score and percentile. Obesity was defined as an age- and sex-adjusted BMI greater than or equal to the 95th percentile. All of the study participants wore the Actical accelerometer on their non-dominant wrist for 6 days, as previously described (Lovinsky-Desir et al., 2017). Activity energy expenditure was calculated and physical activity was characterized as the number of minutes spent in sedentary, light, moderate, and vigorous physical activity. The children were classified as active or non-active based on their achievement of US Department of Health and Human Services (HHS) recommended 60 min daily of moderate to vigorous physical activity (US Department of Health and Human Services, 2018). A clinic visit occurred within 18 months of the home visit (either before or after), during which time questionnaires were completed. The caregivers of the participants completed the BRQ. The caregivers also completed the CBCL if their child was between 9–11 years of age. Children 12–14 years of age completed the YSR independently.

Data Collection

All study data were collected within an 18-month window. As this was a cross-sectional design, each questionnaire was administered only once. A team of study coordinators and technicians were responsible for data collection. The study coordinators ensured that the respondents did not leave blanks on the questionnaires. The technicians were trained by an experienced investigator and periodic re-training and quality control assessments occurred to prevent interrater differences.

Data Analysis

Mann-Whitney U tests were used to determine if there was a difference between children with and without asthma with respect to their reported perceived level of participation and performance in various sports, chores, and leisure activities. Mann-Whitney U tests were again used to determine if there were differences in perceived ability between groups with and without asthma to get along with others. Chi-square tests were used to determine if there was a difference in the number of children with and without asthma who participated in various sports, chores, and leisure activities. Independent *t*-tests were used to find differences in reported number of friends and social gatherings per week, as well as for reported number of nights with interrupted sleep and missed school days. Independent *t*-tests and chi-square tests, as appropriate, were used to identify differences in the number of minutes spent at physical activity levels as recorded on the Actical (Portney &Watkins, 2015). When the sample size allowed, multivariate logistic regression models were used to assess the magnitude of association after controlling for potential confounders including age, sex, ethnicity, insurance, and BMI. Nonparametric

statistical tests were used to analyze nominal and ordinal level data; parametric statistical tests were used for ratio level data. Data were analyzed using SPSS version 24 and significance level was set at $\alpha < .05$.

Results

Cohort Characteristics

One hundred and sixty-three participants were enrolled in the study. Eighteen of the participants (11%) were non-compliant with Actical wear. Sixteen of the participants (10%) did not complete all study components within an 18-month period; therefore, their data were not included in the analysis. Of the 147 participants who completed all study questionnaires, 57% (n = 84) had asthma, 43% (n = 63) were healthy controls; 54% (n = 79) were female, 46% (n = 68) were male; 63% (n = 92) were Dominican, 37% (n = 55) were African American; and all were between 9–14 years of age at enrollment (see Table 1). The children with asthma versus without asthma were similar with respect to ethnicity, household income, sex, age, or body mass index. The participants with asthma were more likely to have public insurance ($p = .04$).

Table 1

Cohort Characteristics

	Asthma (n = 84)	**Non-Asthma (n = 63)**	***P* value**
Ethnicity			.59
Dominican	51 (61%)	41 (65%)	
African American	33 (39%)	22 (35%)	
Household income < 30,000	65 (77%)	42 (67%)	.13
On public insurance	64 (76%)	38 (60%)	.04*
Female	43 (51%)	36 (57%)	.47
Age, mean [min–max], years	12.7 [9.2–14.5]	13.0 [10.4–14.5]	.12
BMI z score, median [IQR]	1.10 [1.30]	1.13 [1.49]	.85
Obesity (≥ 95th percentile)	19 (23%)	16 (25%)	.70

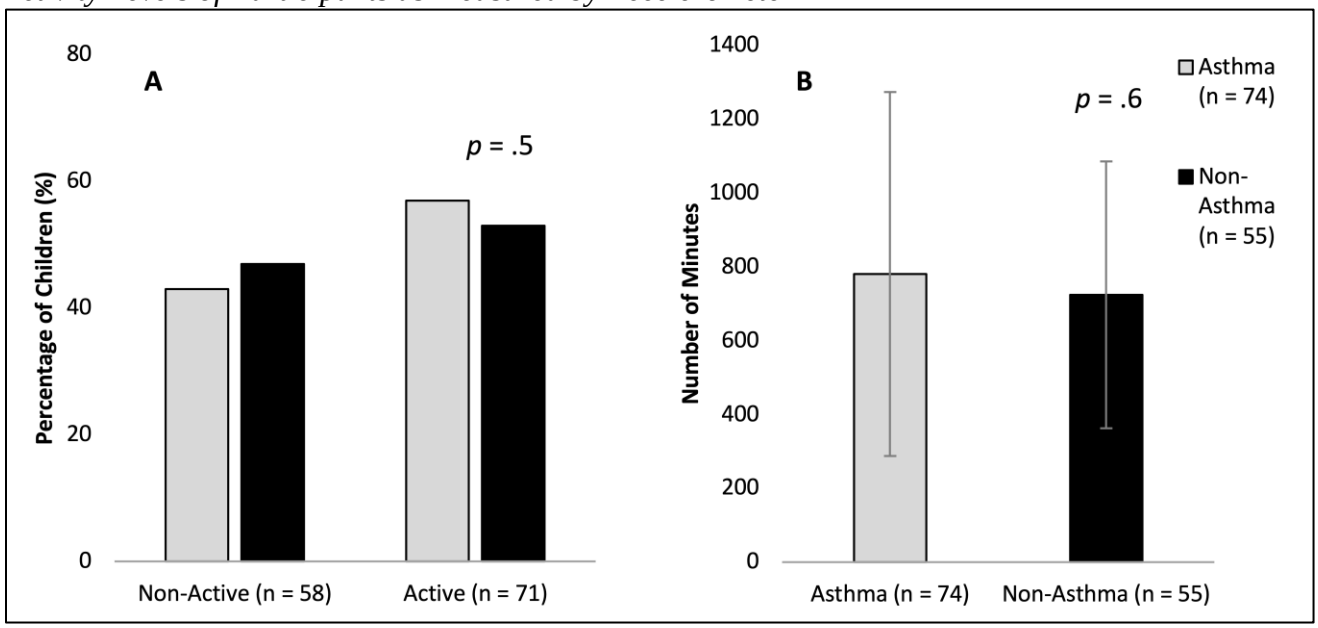
Note. * $p < .05$.

Activity Levels as Measured by Accelerometry

Our group previously demonstrated that the children in this cohort were generally active based on accelerometry data, with 55% achieving HHS recommended ≥ 60 min of moderate to vigorous physical activity daily (Lovinsky-Desir et al., 2016). The children with and without asthma were equally as likely to be active, defined above as achieving the HHS recommended activity level ($x^2 = 0.21$, $p = .6$; see Figure 1). There was no significant difference between the children with and without a diagnosis of asthma with respect to number of minutes spent in moderate to vigorous activity as measured by accelerometer alone ($t = -0.72$, $p = .5$; see Figure 2).

Figure 1

Activity Levels of Participants as Measured by Accelerometer



Note. (A) = Participants who met HHS activity recommendations stratified by asthma status. (B) = Number of minutes spent in moderate to vigorous physical activity over 5 days as measured by accelerometer, stratified by asthma status. Error bars represent standard deviation.

The Impact on Actual and Perceived Levels of Occupational Engagement

The children with asthma, as a whole, however, reported greater perceived engagement in activities that were sedentary as compared to those without a diagnosis of asthma. Although they perceived themselves as participating equally in sports on average (U = 1978.00, p = .9; see Appendix), the children with asthma were significantly less likely to report being members of organized sports teams (x^2 = 6.46, p = .01; see Table 2). In multivariable logistic regression analysis after adjustment for potential confounders, the children without asthma had 2.67 greater odds of participating in organized sports as compared to the children who had asthma (OR 2.67, 95% CI 1.17–6.10, p = .02). Similar to the general asthma sample in this study, the children with asthma who achieved recommended activity levels as measured by accelerometry were still less likely to be members of sports teams than the active children who did not have asthma (x^2 = 4.01, p = .04; see Table 2).

Table 2

Self or Caregiver-Reported Frequency of Engagement

	All Children Stratified by Asthma		**Asthmatic Children Stratified by Obesity**		**Active Children Stratified by Asthma**	
	+Asthma	**-Asthma**	**+Asthma +Obese**	**+Asthma -Obese**	**+Active +Asthma**	**+Active -Asthma**
	n = 84	**n = 63**	**n = 19**	**n = 65**	**n = 42**	**n = 29**
Television (Hours/Week)	M = 3.96* SD = 1.55	M = 4.45* SD = 1.14	M = 4.37 SD = 1.12	M = 3.84 SD = 1.65	M = 3.73 SD = 1.55	M = 4.29 SD = 1.21
Computer (Hours/Week)	M = 3.70 SD = 1.85	M = 3.97 SD = 1.31	M = 4.32* SD = 1.60	M = 3.52* SD = 1.89	M = 3.71 SD = 1.58	M = 3.93 SD = 1.39

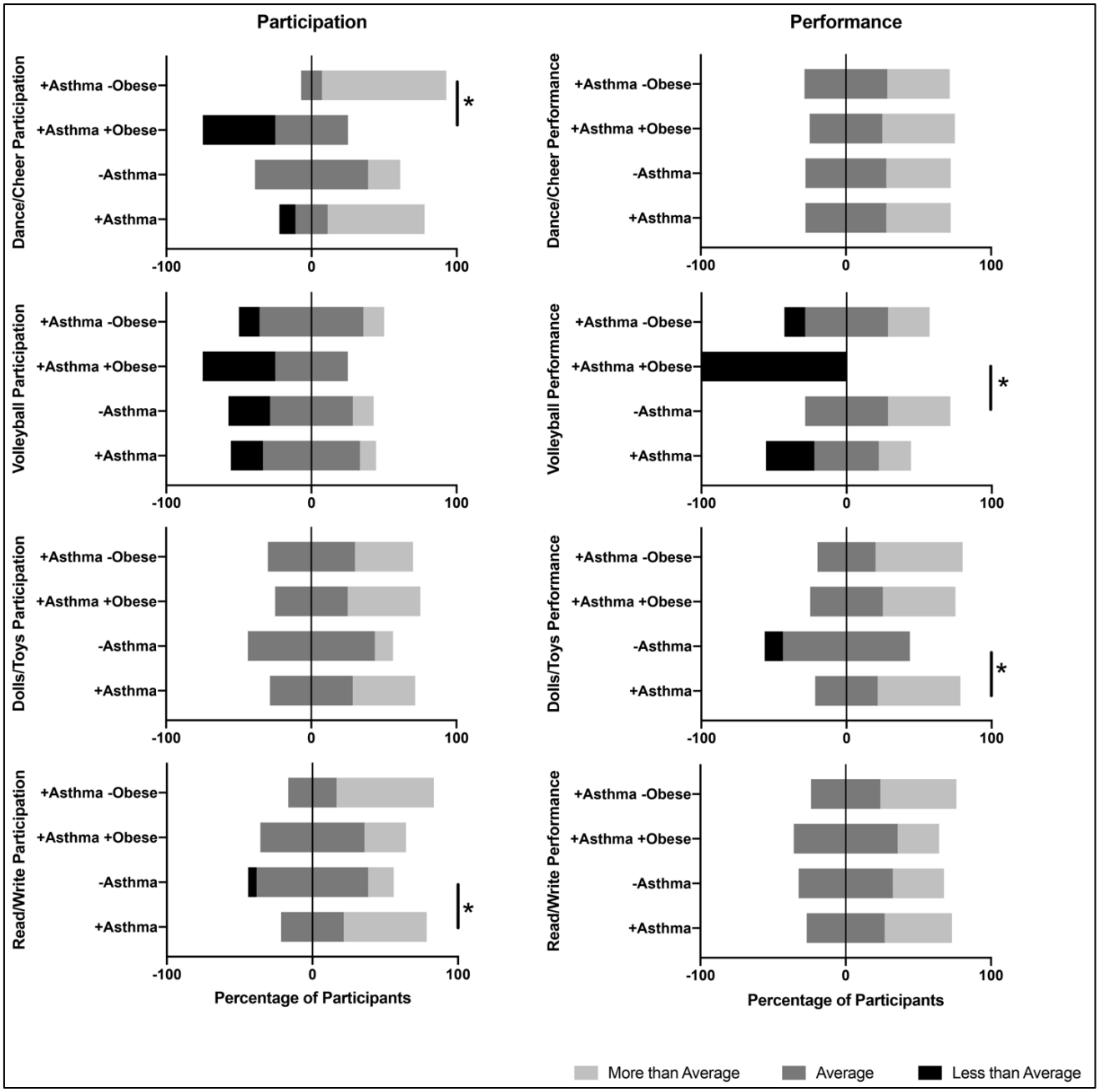
	All Children Stratified by Asthma		Asthmatic Children Stratified by Obesity		Active Children Stratified by Asthma	
	+Asthma n = 84	-Asthma n = 63	+Asthma +Obese n = 19	+Asthma -Obese n = 65	+Active +Asthma n = 42	+Active -Asthma n = 29
Missed School Days	M = 1.57* SD = 6.28	M = 0.05* SD = 0.38	M = 3.63* SD = 12.20	M = 0.95* SD = 2.68	M = 1.48* SD = 3.68	M = 0.11* SD = 0.57
Nights of Troubled Sleep	M = 1.76* SD = 4.63	M = 0.11* SD = 0.89	M = 0.68 SD = 1.64	M = 2.08 SD = 5.17	M = 2.52* SD = 5.48	M = 0.25* SD = 1.32
Frequency Active Leisure	M = 3.37 SD = 1.37	M = 3.08 SD = 1.48	M = 2.67* SD = 1.57	M = 3.59* SD = 1.23	M = 3.31 SD = 1.28	M = 3.14 SD = 1.46
Frequency Sedentary Leisure	M = 2.00 SD = 0.91	M = 1.93 SD = 0.90	M = 1.76 SD = 0.83	M = 2.07 SD = 0.93	M = 1.89 SD = 0.84	M = 1.90 SD = 0.98
Conflict with Parents	M = 1.45 SD = 0.52	M = 1.46 SD = 0.56	M = 1.16* SD = 0.50	M = 1.54* SD = 0.50	M = 1.48 SD = 0.51	M = 1.38 SD = 0.56
Member of Sports Team	13 (15%)*	21 (33%)*	0 (0%)*	13 (20%)*	6 (14%)*	10 (34%)*

Note. M = Mean; SD = Standard Deviation.
* $p < 0.05$.

In addition, significant differences were found with respect to perceived participation in hobbies: the children with asthma perceived themselves as participating more in reading and writing ($U = 138.00$, $p = .01$; see Figure 2) and perceived greater performance with dolls and toys ($U = 10.50$, $p = .02$). The difference with respect to reading and writing remained significant in the model controlling for potential confounders (OR 0.03, 95% CI 0.004–0.32, $p = .003$). The sample size was too small to employ the model for performance with dolls and toys. No significant differences were found with respect to other hobbies reported by the participants and their caregivers (see Appendix). The children with asthma did, however, report watching fewer hours of television than those without asthma ($t = 2.18$, $p = .03$). After controlling for potential confounders, on average, the children with asthma reported spending 0.55 fewer hours per week watching television compared to the children without asthma (95% CI -1.03– -0.07, $p = .02$). The active participants with asthma who achieved the HHS recommended daily physical activity still perceived themselves as spending more time than their peers in sedentary activities compared to participants who met the recommendations but did not have asthma. These participants perceived themselves as participating more in hobbies ($U = 356.50$, $p = .04$; see Appendix) and music and art groups ($U = 0.00$, $p = .02$).

Figure 2

Self-Reported Level of Participation and Performance in Sports and Hobbies as Compared to Peers



Note. Measured by Likert Scale on the CBCL and YSR questionnaires.
* $p < 0.05$.

Sleep and School Attendance

The children with asthma reported a significantly greater number of nights with troubled sleep (t = 3.16, p = .002; see Table 2) and missed school days (t = 2.20, p = .03). In our model controlling for covariates, the relationship between asthma status and troubled sleep was maintained: the children with asthma, on average, reported 1.47 more nights of troubled sleep in the last 12 months (95% CI 0.32–2.62, p = .01). However, obesity was identified as a confounding variable in the relationship between asthma and missed school days.

The Impact of a Dual Diagnosis

Because approximately 25% (n = 35) of the participants were classified as obese, we investigated further the impact of the dual diagnosis of both asthma and obesity on occupational participation. While the children with a dual diagnosis did not differ significantly from others with respect to level of physical activity as measured by accelerometer, analysis of engagement in specific activities yielded many differences between groups. The children diagnosed with both asthma and obesity perceived themselves as spending less time participating in aerobically strenuous activities and more time in sedentary activities. The children with this dual diagnosis were significantly less likely to be members of sports teams as compared to all other study participants ($x^2 = 6.57$, $p = .01$; see Table 2), the children who were not obese but had asthma ($x^2 = 4.50$, $p = .03$), and all participants without asthma ($x^2 = 8.19$, $p = .004$). The children with both obesity and asthma perceived themselves as spending less of their leisure time playing sports as compared to those with asthma who were not obese ($U = 345.00$, $p = .03$). In addition, these children reported significantly more missed school days than all other participants ($t = 2.70$, $p = .008$), including those with asthma who were not obese, although that relationship was not significant ($t = 1.65$, $p = .1$).

The children with both obesity and asthma perceived themselves as participating less than their peers in physical leisure and sport activities, such as dance and cheerleading, as compared to those with asthma alone ($U = 0.50$, $p = .02$; see Figure 2). They also perceived themselves as worse volleyball players than the participants who did not have asthma ($U = 0.00$; $p = .03$) and all other study participants ($U = 1.00$, $p = .02$). As shown in Table 2, the children with both asthma and obesity also perceived themselves as having more conflict than their peers in their relationships with their parents as compared to all other study participants ($U = 829.00$, $p = .01$), the children with asthma alone ($U = 400.00$, $p = .007$), and all participants without asthma ($U = 429.00$, $p = .03$).

Discussion

The purpose of this study was to identify differences in the occupational participation of children with and without a diagnosis of asthma living in New York City. Our first research question asked whether children with asthma participate less in physical activities than peers without asthma. Consistent with previously reported data, a diagnosis of asthma did not have a significant impact on the amount of time a child spent engaging in physical activity as measured by accelerometer. However, significant differences were found when we examined perceived levels of engagement through self-report measures. This discrepancy between actual and perceived level of participation highlights the necessity of a medical team to examine measured versus perceived levels of occupational engagement in order to precisely target psychosocial and physical intervention goals of the child and family.

Our study found that the children with asthma were less likely to report engagement in rigorous activities and reported greater perceived engagement in sedentary occupations as compared to peers without asthma. We found a lower likelihood of being a member of an organized sports team among those with asthma, a finding that surprisingly persisted even among the active children who met the HHS recommended level of daily physical activity. Even so, the children with asthma perceived themselves as participating in sports, organized and informal, to a similar degree to children without asthma. One possible explanation is that parents may be choosing not to enroll their child with asthma in organized sports in an attempt to limit their child's activity because of concern about the risk of an asthma exacerbation. However, our findings indicate that although children with asthma may not as

readily engage in organized sports, they are finding alternative ways to achieve levels of physical activity similar to children without asthma (e.g., informal sports play).

With respect to sedentary activities, the children with asthma perceived themselves as participating more in sedentary hobbies, such as reading and writing, as compared to non-asthmatic peers. Similarly, the active children with asthma perceived themselves as participating more in sedentary hobbies and organizations as compared to their active peers without asthma. It is possible that the perception of engagement in sedentary occupations is a function of the child with asthma, or more likely their parents, placing limits on physically rigorous activities based on fear of potential consequences of the diagnosis, such as exacerbation and hospitalization. This is consistent with prior studies that have shown caregiver fear, especially among minority families, and related activity restrictions (Eisenberg et al., 2020; Holderness et al., 2017).

One unexpected finding is that children with asthma reported spending less time watching television than their peers without asthma. It is possible that these children and their parents, who were receiving services from a large metropolitan children's health center, were provided with education from health care professionals regarding the need to engage in physical activity and limit sedentary occupations. Although this group of children did not engage in sports, they may have been encouraged to reduce television viewing in favor of more active occupations. It is also likely that children with asthma participated in fewer rigorous activities because of asthma exacerbations but may have been encouraged to engage in healthier and more productive sedentary activities, such as reading, writing, music, and art, in contrast to television and video games. These findings are consistent with the reported goals of asthma treatment programs documented in the literature. Many asthma programs emphasize medication compliance and offer education related to increasing knowledge of asthma, monitoring signs and symptoms, and reducing exacerbation risk (John et al., 2020; Salazar et al., 2018). Few programs offer exercise interventions, although these have been shown to have good adherence from participants, improve pulmonary function, and increase quality of life (Abdelbasset et al., 2018; Lu et al., 2018).

As a secondary aim, we also examined the impact of a dual diagnosis of asthma and obesity on activity participation. The children with both obesity and asthma reported spending significantly less time in strenuous activities than those with asthma alone. It is not unexpected, then, that they were also less likely than all other participants to be members of sports teams and perceived themselves as spending less leisure time playing sports than the participants with asthma alone. These results reflect evidence in the literature demonstrating the negative impact of obesity on asthma symptoms and exacerbations (Okubo et al., 2016). While these children would likely benefit from increased physical activity, a dual diagnosis of asthma and obesity appears to restrict their ability to engage in such occupations.

The children with asthma alone perceived themselves as participating more than their peers in dance and cheerleading as compared to the children with the dual diagnosis of obesity and asthma. This finding may indicate that this perceived level of participation was attributable to a diagnosis of asthma rather than obesity. Similar results, although not significant, were found for perceived participation in baseball. It is possible that the participants with asthma alone had heeded the advice of medical professionals to engage in physical activity as a preventive measure against obesity and obesity-related asthma symptoms; however, the participants may have been guided to engage in activities such as baseball and cheerleading, perhaps because of the greater rest breaks these activities afforded during games.

The participants with both asthma and obesity perceived themselves as performing worse than their peers in volleyball as compared to the participants without asthma. Perhaps asthma symptoms occurring during occupational participation adversely impact the children's confidence in their ability to perform. Asthma symptoms may also directly reduce participation, thus facilitating perceived poorer performance in comparison to peers without asthma.

Our second research question asked how sleep and school attendance differed between children with and without a diagnosis of asthma. The children with asthma reported significantly more nights of troubled sleep and more missed school days than their peers without asthma. Both findings are consistent with what has been previously reported in the literature (Martin et al., 2017; Sullivan et al., 2018a). These findings persisted in our investigation of children with asthma who were not obese, indicating that difficulty sleeping and missed school days appear to be more highly associated with the diagnosis of asthma than obesity.

Our third research question asked whether children with asthma participate less with others, and more alone, than their peers without asthma. We found no differences in the perceived number of friends; amount of time spent with friends outside of school; ability to get along with others; or ability to engage in social activities, including play, between children with and without asthma. When we considered children with both asthma and obesity, we found that they perceived themselves as having significantly more conflict with their parents than all other participants. The children with asthma and obesity may experience greater asthma complications that cause parents to limit or restrict their children's desired occupational participation. Such limitation may be perceived by children as reflective of conflict in the parent-child relationship. In addition, some literature indicates that parents of children with asthma miss a substantial number of workdays each year (Sullivan et al., 2018b). Juggling work responsibilities and the health management of an asthmatic child may heighten parental stress levels that are perceived by the children as evident of a strained relationship (Wood et al., 2015).

Limitations

While we believe that our findings are novel and fairly robust, we must acknowledge some study limitations. First, the study participants had diagnoses of mild asthma. A study with a larger sample that includes more children with moderate to severe asthma may be better powered to detect differences in occupational participation. A second limitation was that the participants completed separate questionnaire versions. Because of the age spread of our sample, the children aged 12–14 years of age completed the YSR, while the parents of the younger participants completed the CBCL. Differences between parental and child perceptions may have influenced questionnaire responses. Another limitation with respect to the questionnaires was that they asked the participants and caregivers to report perceived levels of ability and participation, and limited data were collected on actual participation. In addition, the sequence and timing of the study events differed between the participants. Some of the participants completed the clinic visit first and some completed the home visit first, with a window between visits of up to 18 months. A fifth limitation was that the overall sample size was small, limiting between group comparisons with respect to some specific activities. One final limitation was that all of the participants were from the same geographical area of New York City and all were African American or Dominican. The participants from other regions of the country and from different racial and ethnic groups may experience the impact of asthma on daily occupations differently.

Future Research

Exploration of a sample of children with more moderate to severe cases of asthma would substantially add to our study's findings. Based on the discrepancy between levels of actual and perceived engagement found in the present study, future studies should also consider the impact of asthma, with and without the presence of obesity, on the psychosocial aspects of children's lives in order to better understand how asthma impacts occupational participation. It would also be worthwhile to examine differences in the need for and provision of special services, including occupational therapy, for children with asthma. A larger sample size, including children from a wider geographical area and more varied ethnic backgrounds, would enhance the body of research presented here.

Implications for Practice

The aim of this study was to explore differences in the occupational participation of children with and without asthma. Our findings may have implications for all health care professionals, including occupational therapists. Although future intervention effectiveness research is necessary, our results have highlighted the differences that exist in occupational participation that may hinder optimal function in children with asthma. These differences could be ameliorated by an occupational therapist. Occupational therapists can use these results to inform their practice with children having asthma and could provide great benefit to a multidisciplinary team. We found that children with asthma are less likely to engage in aerobically strenuous activities and participate in team sports, have less confidence in their physical performance abilities, have greater sleep disruptions and missed school days, and perceive greater conflict in their relationship with their parents. Occupational therapists can help children with asthma to adapt and grade activities to support participation at levels that do not exacerbate asthma symptoms, but instead foster self-confidence and increased socialization. Therapists can also assist parents and teachers to modify environments and grade activities so that children with asthma can participate in the same desired occupations as those of their peers, thus increasing inclusion and reducing perceived strain in the parent-child relationship. The concepts of activity pacing, energy expenditure, and work simplification can be taught to parents and teachers to help them reconfigure children's daily occupations in the school, home, and community settings to promote desired participation. Therapists can also help parents to (a) use sleep hygiene techniques and (b) modify both the bedroom environment and the bedtime routine to decrease the frequency of nighttime asthma symptoms and disrupted sleep. Children with both obesity and asthma may benefit most from having an occupational therapist on their care team, as their occupational participation appears to be even more restrictive than those of children with asthma alone, placing these children at greater risk for continued overweight conditions and perceived feelings of lowered self-confidence compared to same age peers.

Conclusion

This study demonstrated that significant differences in occupational participation existed in a sample of children with asthma living in the New York City area. Even greater differences in participation were evident when the dual diagnosis of both asthma and obesity were present. The participation limitations evidenced here demonstrate a condition of occupational injustice for children with asthma and their caregivers. Both medical professionals and families should consider the addition of an occupational therapist to their asthma treatment teams to address children's ability to participate in desired daily activities. Future research is warranted both to design and assess occupational therapy interventions that support desired occupational participation for children with asthma and dual diagnoses of asthma and obesity.

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Appendix
Perceived Level of Participation and Performance as Compared to Peers

	All Children Stratified by Asthma		**Asthmatic Children Stratified by Obesity**		**Active Children Stratified by Asthma**	
	+Asthma	**-Asthma**	**+Asthma +Obese**	**+Asthma -Obese**	**+Active +Asthma**	**+Active -Asthma**
Sports						
Baseball	n = 26	n = 15	n = 6	n = 20	n = 12	n = 8
Participate	M = 1.04 SD = 0.60	M = 0.73 SD = 0.70	M = 0.67 SD = 0.52	M = 1.15 SD = 0.59	M = 1.00 SD = 0.43	M = 0.63 SD = 0.52
Perform	M = 1.35 SD = 0.56	M = 1.07 SD = 0.59	M = 1.17 SD = 0.41	M = 1.40 SD = 0.60	M = 1.25 SD = 0.45	M = 1.13 SD = 0.64
Basketball	n = 44	n = 30	n = 7	n = 37	n = 19	n = 15
Participate	M = 1.30 SD = 0.63	M = 1.33 SD = 0.80	M = 1.57 SD = 0.54	M = 1.24 SD = 0.64	M = 1.26 SD = 0.73	M = 1.33 SD = 0.98
Perform	M = 1.20 SD = 0.46	M = 1.27 SD = 0.52	M = 1.14 SD = 0.38	M = 1.22 SD = 0.48	M = 1.16 SD = 0.38	M = 1.33 SD = 0.62
Football	n = 12	n = 11	n = 1	n = 11	n = 4	n = 5
Participate	M = 1.08 SD = 0.67	M = 1.18 SD = 0.75		M = 1.09 SD = 0.70		M = 1.20 SD = 0.45
Perform	M = 1.17 SD = 0.58	M = 1.55 SD = 0.52		M = 1.09 SD = 0.54		M = 1.60 SD = 0.55
Swim	n = 21	n = 11	n = 7	n = 14	n = 9	n = 7
Participate	M = 0.81 SD = 0.68	M = 0.91 SD = 0.54	M = 0.71 SD = 0.76	M = 0.86 SD = 0.66	M = 1.11 SD = 0.33	M = 1.00 SD = 0.00
Perform	M = 1.38 SD = 0.74	M = 1.18 SD = 0.41	M = 1.57 SD = 0.79	M = 1.29 SD = 0.73	M = 1.44 SD = 0.53	M = 1.14 SD = 0.38
Average of Sports	n = 76	n = 53	n = 16	n = 60	n = 39	n = 23
Participate	M = 1.09 SD = 0.48	M = 1.12 SD = 0.57	M = 0.93 SD = 0.48	M = 1.13 SD = 0.48	M = 1.11 SD = 0.48	M = 1.18 SD = 0.68
Perform	M = 1.28 SD = 0.49	M = 1.24 SD = 0.44	M = 1.22 SD = 0.59	M = 1.29 SD = 0.47	M = 1.24 SD = 0.48	M = 1.24 SD = 0.52
Hobbies						
Reading & Writing	n = 28	n = 17	n = 7	n = 21	n = 16	n = 10
Participate	M = 1.57* SD = 0.50	M = 1.12* SD = 0.49	M = 1.29 SD = 0.49	M = 1.67 SD = 0.48	M = 1.56 SD = 0.51	M = 1.10 SD = 0.57

Perform	M = 1.46 SD = 0.51	M = 1.35 SD = 0.49	M = 1.29 SD = 0.49	M = 1.52 SD = 0.51	M = 1.44 SD = 0.51	M = 1.40 SD = 0.52
Video Games	n = 11	n = 16	n = 2	n = 9	n = 5	n = 4
Participate	M = 1.27 SD = 0.65	M = 1.31 SD = 0.60		M = 1.22 SD = 0.67	M = 1.60 SD = 0.55	
Perform	M = 1.45 SD = 0.82	M = 1.50 SD = 0.52		M = 1.33 SD = 0.87	M = 1.80 SD = 0.45	
Average of Hobbies	n = 73	n = 54	n = 18	n = 55	n = 40	n = 25
Participate	M = 1.36 SD = 0.50	M = 1.22 SD = 0.43	M = 1.34 SD = 0.56	M = 1.37 SD = 0.48	M = 1.43* SD = 0.49	M = 1.18* SD = 0.41
Perform	M = 1.33 SD = 0.48	M = 1.30 SD = 0.42	M = 1.34 SD = 0.56	M = 1.32 SD = 0.46	M = 1.34 SD = 0.48	M = 1.29 SD = 0.46
Chores						
Babysit	n = 15	n = 15	n = 2	n = 13	n = 7	n = 9
Perform	M = 1.53 SD = 0.52	M = 1.13 SD = 0.64		M = 1.54 SD = 0.52	M = 1.57 SD = 0.54	M = 1.11 SD = 0.60
Clean Bedroom	n = 32	n = 22	n = 5	n = 27	n = 20	n = 12
Perform	M = 1.16 SD = 0.68	M = 1.41 SD = 0.50	M = 0.80 SD = 0.45	M = 1.22 SD = 0.70	M = 1.20 SD = 0.62	M = 1.42 SD = 0.52
Dishes	n = 28	n = 20	n = 4	n = 24	n = 12	n = 11
Perform	M = 1.14 SD = 0.45	M = 1.05 SD = 0.51		M = 1.17 SD = 0.48	M = 1.25 SD = 0.45	M = 1.18 SD = 0.41
Average of Chores	n = 60	n = 49	n = 12	n = 48	n = 33	n = 24
Perform	M = 1.24 SD = 0.58	M = 1.22 SD = 0.43	M = 1.08 SD = 0.51	M = 1.28 SD = 0.59	M = 1.31 SD = 0.56	M = 1.21 SD = 0.35

Note. Participate = Perceived level of participation; Perform = Perceived level of performance; M = Mean; SD = Standard Deviation; Average of sports = Average of levels of performance and participation for all sports in which the child engaged; Average of hobbies = Average of levels of performance and participation for all hobbies in which the child engaged; Activities with fewer than 20 participants are not included individually in the table, but the results are included in average scores.
* $p < 0.05$.