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Is sports participation protective for child mental health?

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IS SPORTS PARTICIPATION PROTECTIVE FOR CHILD MENTAL HEALTH?

by

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DEDICATION

I would like to dedicate this thesis to Daniel M. Davis and Adam Perea-Kane, my wise old wizards and my best friends. Thank you for always pushing me to see the human fire in my work.

"In one's friend, one shall have one's best enemy. You should be closest to him with your heart when you oppose him."

-Friedrich Nietzsche

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IS SPORTS PARTICIPATION PROTECTIVE FOR CHILD MENTAL HEALTH?

PUNIT MATTA

ABSTRACT

Introduction:

Psychiatric disorders are among the most common illnesses in children. Most psychiatric disorders begin in childhood but most children with psychiatric symptoms receive delayed or no treatment. A resilience-based strategy for at-risk children in primary care, such as enhancing childhood sports participation, could be an effective and feasible early intervention. Existing literature demonstrates an association between sports participation and mental health in adolescents and adults, and that exercise can improve depressive symptoms. There are few studies on the link between mental health and sports participation in children under twelve.

Objective:

Since sports participation could be a simple and potentially available intervention for mental health, we investigated the association between sports participation in children ages 6-11 and measures of psychiatric impairment.

Methods:

We performed linear regression analyses between measures of psychiatric symptoms (total number of CBCL/6-18 syndrome scale elevations and individual syndrome scale elevations) and sports participation as measured by the number of parent-reported sports, with demographic factors as covariates.

Results:

The association between sport count and number of CBCL syndrome scale elevations was not significant ($p = 0.638$). However, we found a significant association between fewer numbers of sports reported and higher T-scores on the Withdrawn/Depressed CBCL syndrome scale ($p = 0.019$) and was also significant for age ($p = 0.003$) and ethnicity ($p = 0.037$).

Conclusion: Playing one or fewer sports during childhood is associated with higher withdrawn/depressive symptoms in school-age children. This replicates earlier findings which suggest that sports participation may be protective for child mental health.

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LIST OF ABBREVIATIONS

ADHD ..... Attention-deficit/hyperactivity disorder

CBCL……Child Behavior Checklist

CBCL/6-18 ..... Child Behavior Checklist for ages 6-18

IRB ..... Institutional Research Board

MDD……..……..……..Major Depressive Disorder

SES……..……Socioeconomic Status

SPSS 24……..……IBM Statistical Package for the Social Sciences, Version 24

INTRODUCTION

Psychiatric illnesses are among the most common in children, and suicide is the third leading cause in adolescents.[2,10] A survey of adolescents in 2010 found that nearly 1 in 5 had a psychiatric condition that caused "severe impairment or distress.[31]" Most psychiatric disorders onset during childhood,[13,27] and psychiatric diagnoses made in early childhood are persistent and stable.[13,14,16]

Despite the frequency of mental health problems in childhood, most children do not receive treatment, for multiple reasons including lack of providers, cost of care, logistical barriers to treatment, and lack of knowledge about where to seek treatment. Disparities also exist in the treatment of psychiatric disorders - minority and poor children are even less likely to receive care.[15,26] Massachusetts offers an interesting case study of the mismatch between identification and treatment. In 2007, the state instituted mandatory screening for behavioral health problems at primary care visits for children covered by Medicaid, leading to a nearly 100% jump in the percentage of patients identified with a behavioral health problem.[40] Still, a minority of those who screened positively actually received care.[24]

While screening is important, referral to a specialist represents an important barrier to care due to multiple factors like finances, transportation, availability and accessibility of providers. The point of care for behavioral issues is increasingly the primary care office.[3,5] Thus, alongside the increase in screening has come an interest in feasible interventions that can be set into motion at the primary care level. Furthermore, low-intensity interventions targeting children at risk for mental health problems in primary care could prevent the development of fully symptomatic psychiatric conditions that would then require specialty care.

Youth sports participation is one possible low-intensity intervention. The association between sports participation and mental health, as well as physical activity and mental health, is widely studied, particularly in adults and adolescents. Physical activity has been shown to improve certain symptoms of attention-deficit/hyperactivity disorder (ADHD) and may also alleviate depressive symptoms.[18,19,28] Participation in sport, which immerses the player in a particular competitive and social environment, has also been shown to be protective of mental health.[23,47] Physical activity in childhood and adolescence has been shown to predict increased physical activity in adulthood, emphasizing

the effectiveness of early intervention.[34,42] If it confers the same benefit to school age children (ages 6-12,) sports participation or other means of increasing physical activity could represent a valuable low-impact intervention to improve and protect mental health.

The objective of this study was to assess the relationship between sports participation and psychiatric symptoms in school-age children presenting for well child visits in primary care. We used an existing data set collected at well-child visits at an urban community health center serving a predominantly Spanish-speaking population.

METHODS

Methods:

The data for this study was collected from well-child visits at the Pediatric Unit of the Massachusetts General Hospital Chelsea Healthcare Center (MGH Chelsea) in Chelsea, MA.[41] The clinic is located in Chelsea, MA, which is one of the most densely populated cities in the country and home to a significant immigrant population, particularly Spanish-speaking.

This study was conducted with data from 241 children, ages 6-11, whose parents completed a Child Behavior Checklist for ages 6-18 (CBCL/6-18) at a well-child visit at a diverse, urban community health center for well-child visits. Parents filled out the CBCL/6-18 for the 6-11 age range during this visit.

The Partners Healthcare Human Research Committee approved this study. The Boston Medical Center IRB approved this secondary analysis.

Measures:

All variables in this analysis were drawn from parent self-report responses on the Child Behavior Checklist for ages 6-18. The CBCL is a well-validated self-

report questionnaire to assess past month emotional, behavioral, and social problems in children.[43] It consists of two parts. The first part includes items about the child's life and environment, ranging from parent demographics to the child's performance in school, social interactions, and participation in activities. These items are grouped into three "competence scales" which allow assessment of a child's functioning. The second part consists of 113 symptom questions whose answers are scored on a 3-point Likert scale from 0-2 (not true, somewhat true, or very true). The items are grouped into eight empirically-based "syndrome scales" based on factor analyses, indicating different categories of psychiatric/behavior problems.

Primary outcome: # of subscale elevations

The CBCL includes eight empirically-based syndrome scales: anxious/depressed, withdrawn/depressed, somatic complaints, social problems, thought problems, attention problems, rule-breaking behavior, and aggressive behavior. These syndrome scales can also be grouped into three broad-band scales which indicate internalizing (scales I-III), externalizing (scales VII-VIII), and other problems (scales IV-VI). The Likert responses for each question on a scale are added up to produce a raw score. The raw-score was then transformed into a T-score using a

computer program or conversion table. A T-score of 50 indicates average symptoms compared to other children with the same age and gender. Every 10-point increase in T-score represents one standard deviation from the norm.

The number of CBCL subscale elevations has been utilized as a marker of general psychiatric impairment in prior literature.[41] We determined this to be a general yet robust measure of potential psychiatric problems in our sample.

Secondary outcomes: CBCL syndrome subscale T-scores

Patients' T scores on each of the eight "syndrome scales" were skewed toward subclinical scores given that the data was collected from patients at well-child visits, most of whom did not have subscale elevations on the CBCL. We tested two cut-off points on these T-scores: 1) 60, which is one standard deviation about the mean; and 2) 65, which is reported as the cut-off for a "borderline clinical" score in the CBCL scoring instructions. We did not test a cut-off of 70 since 1) so few patients had such high scores, given that this was a well sample, and 2) we were interested in associations with more mild symptoms as well to facilitate early intervention. Additionally, previous studies support good clinical correlations between cut-off of 60 on CBCL scores and psychiatric diagnosis.[6,12]

Predictor variable: sports participation:

Parents can report up to three sports and up to three activities in response to the CBCL questions: "Please list up to three sports your child likes to participate in" and "Please list your child's favorite hobbies." Answers were recorded as words or phrases in either English or Spanish. We found that parents reported sports as answers to both of these questions.

Since recorded sports were not confined to the sports variables, we created a coding scheme that caught sports that were listed as hobbies and generated a count of total sports for each participant; this ranged from 0-5. (**expanded sport count)** We also tested another variable which only included responses to the three fields explicitly for sports on the CBCL. (basic sport count) As continuous variables, both measures of sport count followed a relatively normal distribution.

Table 1: CBCL responses counted as "sports"

Baseball	"net" (tennis, volleyball)
Basketball	"other" (bowling, fishing, boating)
Cycling	"pelota"
Dance	"road" (rollerskating, scooter, skateboarding)
Football	running
Hockey	Soccer
Lacrosse	swimming
"movement" (gymnastics, cheerleading, martial arts, dance, wrestling, yoga)	Ice skating

Table 2: Descriptive statistics for sport count variables

	Basic Sport Count	**Expanded Sport Count**
N	206	206
Mean	1.72	1.46
Median	2.00	1.00
Mode	1.00	1.00
Skewness	0.201	0.232
Kurtosis	-0.815	-1.077

Figure 1: Frequency of sports: basic count

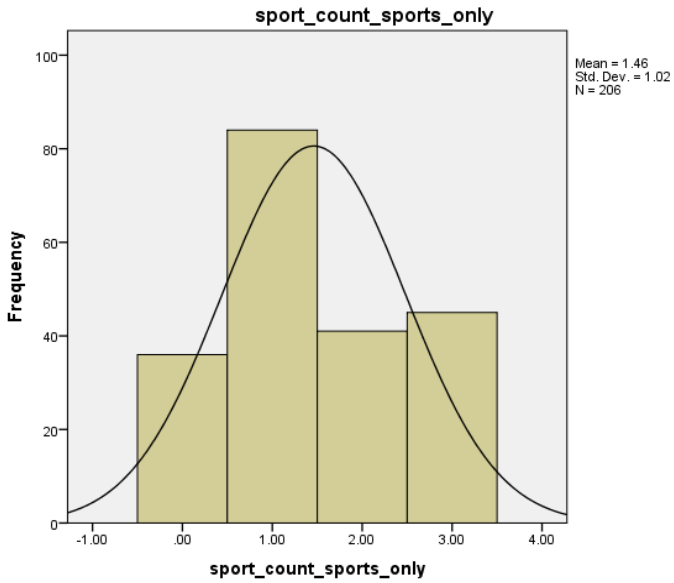
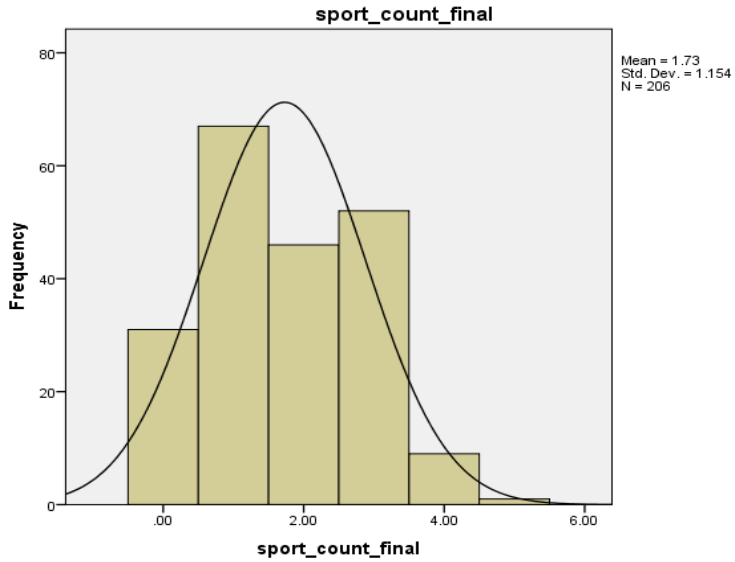


Figure 2: Frequency of sports: basic count



Our post-hoc testing was concerned with the specific number of sports for which an association held. We converted both measures of sport count to several

dichotomous variables, each with a different cutoff point of the number of sports. We compared participants who played 0 sports vs. participants who played 1+, participants who played 0-1 sports vs. participants who played 2+, and participants who played 0-2 sports vs. participants who played 3+.

We were also interested in whether participation in team vs. non-team sports would differ based on psychiatric symptoms, based on previous literature indicating that team sports participation in particular is associated with psychiatric symptoms and greater prosocial benefits.[1,32,38] Furthermore, our clinical experience suggests that children with social difficulties related to psychiatric symptoms seem more likely to play individual sports.

Covariates: age, sex, ethnicity, and language

Demographic features, such as age, sex, and ethnicity, are associated with differences in psychiatric symptoms across populations. The prevalence of major depressive disorder (MDD) for example is about twice in women as it is in men[39] while childhood ADHD and disruptive behavior disorders are is more prevalent in males than in females.[4] The question of diagnosis versus pathology is particularly relevant to ADHD since females with ADHD tend to be diagnosed

later or missed entirely due to their display of inattention over hyperactivity, i.e. a less-conspicuous expression of the disease.[11] In children, psychiatric symptoms tend to increase with age, likely due to a child's increasing level of engagement with people and institutions and ability to articulate what is going on.[31] There are also significant differences between ethnic groups in both the diagnosis and treatment utilization for psychiatric disorders, with non-Asian minorities having both higher rates of diagnosis but lower utilization of treatment in school settings.[38,39]

The literature around sports participation and gender is mixed. Large surveys in adults find that individuals who identify as male participate in sports more often than those identifying as female.[17,46] Studies involving children, which often include a smaller sample recruited in schools, tend to find more mixed results, with girls showing more participation in certain types of sports than boys.[25,32] This makes sense since schools tend to offer more choice of sports and time dedicated to them for their students than adults can have. Sports participation also tends to drop off among school-age children as they grow older. Sports participation has been found to be lower among ethnic minorities and immigrants, in many cases coinciding with low SES.[45,50] Given their complex

relationship to both psychiatric diagnoses and sports participation, we felt it was important to control for age, gender, and ethnicity in our analysis.

As the prevalence of gender dysphoria has increased in recent years, the distinction between sex and gender has become increasingly germane to clinical practice and a crucial part of the therapeutic alliance with these individuals.[51] Some individuals with gender dysphoria choose to transition, but some do not as a result of choice, nonconformity of identity with binary human biology, or other constraints. In many cases, this "gray area" is an integral part of an individual's identity and should be respected as such. At the same time, it creates ambiguity in the context of differential treatment for cis males and females based on differing hormone levels, anatomy, and other differences in biology. As a result of this, the term "genetic sex" seems like a more accurate term than "biological sex," which tends to refer to anatomy, when discussing sex and gender in a medical context. However, unless explicitly dealing with the issue of gender dysphoria, scientific literature tends to use sex and gender interchangeably when talking about the differences between cis humans. Since the CBCL also seems to conflate these two terms in asking parents to report their child's sex, we are therefore limited in our ability to be inclusive of gender identities and how

dysphoria may affect our results. To remain consistent with our data set, we use 'sex' to represent this covariate.

The CBCL provides a place for parents to report their child's age, sex, and ethnicity. Ages ranged from 6-11, with only one 11-year-old. The CBCL did not provide any further information about a child's gender identity beyond the parent's report of their child's sex. Our ethnicity data was unfortunately quite limited. Parents could indicate whether their child was Hispanic or Latino or not. 85% of our sample was Hispanic or Latino. As another way to approximate ethnicity, we used the variable indicating the language in which the CBCL was filled out: English or Spanish. There were two places where participants could indicate their race and while most participants wrote 'unknown' or left it blank, the other responses mostly indicated descent from Central or South American countries.

Data Analysis:

Data analysis was performed using IBM's Statistical Package for the Social Sciences Version 24 (SPSS 24.) We reported demographic factors like age (mean

and SD), sex, ethnicity, and language (frequency and percentage of sample.) We also reported the amount and percentage of our sample who had at least one subscale elevation and the frequencies and percentages for each individual subscale and broad-band subscale.

Simple linear regression:

We performed a simple linear regression between sport count and the number of subscale elevations of T ≥ 60 (our primary outcome) and the individual CBCL syndrome scales (our secondary outcome.)

Multivariate linear regression

Since age, gender, and ethnicity are all associated with psychiatric symptoms, we chose to include them as covariates in our linear regression model. We also included language as a covariate. Our multivariate linear regression took sport count as a predictor, the number of subscale elevations of T ≥ 60 as our primary outcome, and the individual CBCL syndrome scales as our secondary outcome.

Multivariate logistic regression

We dichotomized our outcome variables into groups of 0 and 1+ subscale elevations and groups of T-scores below 60 and equal to or above 60 for the individual subscales. Sport count was our predictor, the number of subscale elevations of T ≥ 60 was our primary outcome, and the individual CBCL syndrome scales was our secondary outcome. Age, gender, ethnicity, and language were all included in our model as covariates.

Post-hoc testing

With our post-hoc testing, we hoped to further establish the clinical relevance of our results. We were interested in whether a specific number of sports played was protective. We conducted chi-square analyses between dichotomous categories of sports participation and elevated/non-elevated categories of T-scores for all eight CBCL syndrome scales. We generated three dichotomous variables from each existing sport count variable, using cutoffs at different numbers of sports, for a total of six variables. We checked for interactions using the Breslow-Day test and for confounding using the 10% rule.[30]

RESULTS

Demographics:

Of 241 total participants in the data set, 206 participants had completed CBCL questionnaires; participants with incomplete questionnaires were excluded from the study. The sample was almost evenly split by gender (50.5% male, 49.5% female) and two-thirds of the parents completed the CBCL in Spanish (66.5%).

Table 3: Sample demographics

Demographics	**N = 206**
Age (Mean ± SD)	**7.9 (1.4)**
Sex (n(%)	
Male	104 (50.5%)
Female	102 (49.5%)
Child ethnicity	
Hispanic/Latinx	175 (85.0%)
Not Hispanic/Latinx	31 (15.0%)
Parents' primary language, n(%)	
English	69 (33.5%)
Spanish	137 (66.5%)
# of participants with at least 1 subscale elevation (T ≥ 60)	**105 (51%)**
CBCL Positive scores (T ≥ 60) n(%)	
Anxious/Depressed	30 (14.6%)
Withdrawn/Depressed	45 (21.8%)
Somatic Complaints	45 (21.8%)
Social Problems	38 (18.4%)
Thought Problems	25 (12.1%)
Attention Problems	38 (18.4%)
Rule-Breaking Behavior	33 (16.0%)
Aggression	33 (16.0%)

Internalizing Positive scores (T ≥ 60) n(%)	
Male	23 (22.1%)
Female	16 (15.7%)
Externalizing Positive scores (T ≥ 60) n(%)	
Male	23 (22.1%)
Female	15 (14.7%)

Simple linear regression:

Using both the basic and expanded sport counts, there was no significant association between the number of subscale elevations of a participant and the number of sports they played. Using both the basic and expanded sport counts, more reported sports were associated with lower scores on the Withdrawn/Depressed subscale (basic sport count $p = 0.016$; expanded sport count $p = 0.009$). The other subscale T-scores were not significantly associated with sport count.

Table 4: Association between CBCL subscale elevations and basic sport count

CBCL outcome	βestimate	t-value	p-value
# of subscale elevations	0.033	0.471	0.638
Anxious/Depressed subscale	0.061	0.872	0.384
Withdrawn/Depressed subscale	-0.168	-2.434	**0.016***
Somatic Complaints subscale	0.110	1.581	0.115
Social Problems subscale	0.028	0.394	0.694
Thought Problems subscale	0.073	1.053	0.294
Attention Problems subscale	0.044	0.631	0.529
Rule-Breaking Behavior subscale	0.064	0.921	0.358
Aggressive Behavior subscale	0.059	0.838	0.403

*: $p < 0.05$

*** Predictor: basic sport count

Table 5: Association between CBCL subscale elevations and expanded sport count

CBCL outcome	βestimate	t-value	p-value
# of subscale elevations	-0.015	-0.213	0.832
Anxious/Depressed subscale	0.008	0.112	0.911
Withdrawn/Depressed subscale	-0.182	-2.643	**0.009****
Somatic Complaints subscale	0.046	0.665	0.507
Social Problems subscale	-0.006	-0.080	0.936
Thought Problems subscale	-0.004	-0.055	0.956
Attention Problems subscale	0.012	0.169	0.866
Rule-Breaking Behavior subscale	0.043	0.619	0.536
Aggressive Behavior subscale	0.015	0.212	0.832

**: $p < 0.01$

*** Predictor: expanded sport count

Multivariate linear regression:

We performed a multivariate linear regression in which the number of clinical subscale elevations was our primary outcome, individual clinical subscale elevations were our secondary outcomes, and sport count was our predictor. Since the age, gender, and ethnicity of children can contribute to their symptom

presentation and diagnosis, we felt it prudent to incorporate these factors into our regression model.

In this model, sport count remained significantly associated with the Withdrawn/Depressed subscale with the same directionality: that is, a higher number of sports played was associated with lower scores on the subscale. Age was also significantly associated with this subscale with the opposite directionality. The older the child, the likelier they were to have elevations in the Withdrawn/Depressed subscale. No predictor variable was significantly associated with elevations in any other subscale nor the total number of subscale elevations.

Table 6: Association between CBCL Withdrawn/Depressed subscale elevations and covariates (basic sport count)

CBCL outcome	Predictor	βestimate	t-value	p-value
Withdrawn/Depressed subscale	Basic Sport Count	-0.160	-2.390	**0.019****
	Age	0.205	3.017	**0.003****
	Sex	-0.115	-1.488	0.088
	Ethnicity	-0.171	-2.102	0.037
	Parent Language	-0.002	1.366	0.980

**: $p < 0.01$

Table 7: Association between CBCL Withdrawn/Depressed subscale elevations and covariates (expanded sport count)

CBCL Outcome	Predictor	βestimate	t-value	p-value
Withdrawn/Depressed subscale	Expanded Sport Count	-0.176	-2.625	**0.009****
	Age	0.204	3.048	**0.003****
	Reported Gender	-0.117	-1.745	0.082
	Ethnicity	-0.169	-2.085	0.038
	Parent Language	0.004	0.045	0.964

**: $p < 0.01$

Multivariate logistic regression:

The published cutoff for a clinically elevated CBCL subscale is a T-score of 65. However, a lower clinical cutoff of 60 has been used in previous studies for the purpose of identifying comorbidities in existing psychiatric patients or when assessing certain special populations.[3–5] Additionally, since it represents one standard deviation above the mean, a T score of 60 could represent a meaningful departure from normal behavior.

Table 8: Association between CBCL Withdrawn/Depressed subscale elevations (cutoff: T = 60) and covariates (basic sport count)

CBCL Outcome	Predictor	Wald χ^2	Exp(B)	95% CI for Exp(B)	p-value
Withdrawn/Depressed subscale	Basic Sport Count	2.715	0.735	0.509-1.060	0.099
	Age	8.587	1.451	1.131-1.860	**0.003****
	Sex	0.007	0.970	0.483-1.947	0.931
	Ethnicity	2.303	0.280	0.054-1.449	0.129
	Language	0.328	1.310	0.520-3.298	0.567

**: $p < 0.01$

Table 9: Association between CBCL Withdrawn/Depressed subscale elevations (logistic cutoff: T = 60) and covariates (expanded sport count)

CBCL Outcome	Predictor	Wald χ^2	Exp(B)	95% CI for Exp(B)	p-value
Withdrawn/Depressed subscale	Expanded Sport Count	3.064	0.753	0.548-1.035	0.080
	Age	8.527	1.449	1.130-1.858	**0.003****
	Sex	0.010	1.036	0.516-2.081	0.921
	Ethnicity	2.363	3.620	0.701-18.663	0.124
	Language	0.353	0.757	0.302-1.899	0.553

**: $p < 0.01$

We dichotomized our primary outcome variable into three pairs. It seemed most intuitive to distinguish between participants with 0 and 1+ subscale elevations. A cutoff between 0-2 and 3+ subscale elevations has been found in a prior study of this data set to maintain a good balance between sensitivity and specificity for the CBCL to diagnose complex ADHD.[41] With these two in mind, we also decided to test a cutoff between 0-1 and 2+ subscale elevations. We organized our secondary outcome variables into groups who had T scores between 0-59 and 60-100. Only the Withdrawn/Depressed subscale continued to be associated with

age but both sport count predictors just missed significance in their association (p = 0.080 for basic sport count, p = 0.099 for expanded sport count.)

Post-hoc testing:

Our goal for this research was to determine whether sports participation could be an effective intervention to recommend for alleviation of psychiatric symptoms. In order to determine the clinical relevance of our results, we conducted post-hoc testing to determine whether a certain number of sports played was protective of mental health. We found that children who reported playing one or fewer sports were about twice as likely to have clinically elevated Withdrawn/Depressed syndrome scores on the CBCL than those who played two or more.

Table 10: Chi-square between Withdrawn/Depressed T-scores ($T < 60$, $T \geq 60$) and sport count (0-1, 2+)

	X^2	p-value	Odds ratio (95% CI)
Basic Sport Count	5.385	0.020	2.339 (1.127-4.853)
Expanded Sport Count	4.954	0.026	2.141 (1.086-4.220)

Age, sex, ethnicity, and parent language showed no significant interaction or confounding effect on the results. We tested cutoff points of 0, 1+ and 0-2, 3+ sports with non-significant results.

DISCUSSION

We found that higher scores on the CBCL's Withdrawn/Depressed syndrome scale were associated with fewer sports reported by participants aged 6-11. This is consistent with limited existing literature that sports participation is associated with fewer depressive symptoms in children of the same age, as well as with the more extensive literature around adolescents and adults.[7,32,47]

To our knowledge, ours is the first study to look at the association between mental health symptoms and parent-reported sports participation at well child visits. This is also the first study we know of to examine this association in Latino, socioeconomically disadvantaged children, and one of very few studies examining this question in school-age children in the U.S. Our findings suggest that asking about sports participation could be a helpful additional measure of psychosocial functioning and a point for early intervention, especially where finances and other social determinants may be a barrier to care.

Prior research has examined the association between sports participation or physical activity and psychiatric symptoms in psychiatric samples and in general population surveys.[8,18,28,29,48] Patients at well-child visits may represent an

important middle population: while they lack a formal diagnosis, their parents are concerned enough to bring the child in for a routine visit versus skipping it. This logic begs the question of selection bias, of finding cases only where the streetlight is shining. Furthermore, parents who have the time and resources to bring their children to routine visits are likely to benefit from higher medical literacy and SES which are associated with higher rates of diagnosis and treatment. Given that our sample is drawn from one of the poorest areas in Massachusetts and is two-thirds Spanish-speaking, we believe that our results identified legitimate pathology beyond concerns of the "worried well." Half of our patients had at least one CBCL subscale elevation and the fact that they are connected with medical care indicates that well-child visits could be an effective point of intervention.

The major barrier to collecting additional information about psychosocial functioning is likely time. The most widely used screening questionnaire in pediatrics, probably due to its simplicity, is the Pediatric Symptom Checklist (PSC). The PSC consists of 35 questions purely related to broad-band psychiatric categories (Attention, Internalizing, and Externalizing) and can be completed and scored within a few minutes. Adding questions about a child's life will

naturally strain the bounds of a normal primary care appointment, but since sports participation is associated with symptoms of depression, it, and other measures of function, may serve as early and more casual bellwethers of psychiatric issues. Adding a short measure of functioning to primary care psychiatric screens would provide an expanded view to the clinician both for screening purposes

We have been careful to distinguish "sports" from "physical activity" for two reasons. First, literature tends to refer to one or the other specifically and they tend to be separate categories under investigation. Regardless of these research categories, an organized version of a sport is a different experience from an unorganized version. A child playing soccer in a travel league will experience different social, competitive, and financial circumstances from a child who plays pickup soccer with their neighborhood at night or with their family in the backyard. The question of organized vs. casual is particularly germane to our data set. Our main predictor variable was "sports participation" because the CBCL explicitly asks about sports, not physical activity. However, the CBCL does not ask about the manner in which these sports are played. This is a limitation of our secondary analysis of this data: the original study was not set

up to delve into specifics about sports. Given our results, future research should ask questions in order to better understand which aspects of sports participation confer benefits. One of the considerations we made when cleaning the data was how to account for responses that were explicitly sports, such as "football" or "baseball," that were reported under the "activities" category. The "expanded sport count" variable included such responses in the count but also created ambiguity about the nature of the sport: organized or casual? Our "basic sport count" variable lessens this ambiguity a bit, but not entirely since a question explicitly asking about sports may prime a parent to think of an organized activity. Organized sports might carry prosocial benefits over casual play but may also negatively affect children through competitive pressure or blows to the self-esteem.

This study raised several questions which may not be fully assessable with the current data. Future studies could collect data with an eye to fleshing these out. We have touched on the difference between "sports" and "physical activity" for the purpose of research and follow-up study could define this difference more precisely: what are the pros and cons of self-directed exercise versus competition with a sports team? Our post-hoc results hinted at this question. The fact that we

observed an association at a cutoff between 1 and 2 sports played, but not at a lower or higher cutoff, suggests that 2 sports might be a balance point where the positives of sports participation outweigh the potential negatives. When the cutoff is higher or lower, at 0 vs 1+ sports or 0-2 vs. 3+ sports, these positives may be subsumed by the negative effects of playing fewer or more sports than 2.

The difference between "sports" and "physical activity" elicits the question about differences between types of sports. To investigate these differences, we tried grouping sports into several different categories: organized vs. casual; contact vs. non-contact; and team vs. non-team. We were particularly interested in whether participation in team vs. non-team sports would differ based on psychiatric symptoms, based on previous literature indicating that team sports participation in particular is associated with psychiatric symptoms and greater prosocial benefits.[1,32,38] Furthermore, our clinical experience suggests that children with social difficulties related to psychiatric symptoms seem more likely to play individual sports. With non-team sports, we found that it was hard to distinguish whether certain sports, such as cycling or swimming, might occur on a team despite requiring individual praxis, as an individual pursuit in an organized league, or if the sport was just a hobby. This question also holds for

explicitly team sports like football or soccer, but to a lesser extent. We attempted to control for this by establishing the "basic sport count" variable but the ambiguity about the environment in which these sports are played made it difficult for us to classify them with certainty. Therefore, we did not feel we could make a legitimate attempt to investigate differences in outcome related to the types of sports played. Future studies could account for this with questions about the venue and character of the sports played.

Further questions could ask about the time spent or effort expended on each sport reported by participants. The CBCL has response options which ask "about how much time does he/she spend on each sport/activity" and "how well does he/she do on each sport/activity." However, these are scored on a three-point Likert-type scale, from 0-2, with responses of "less than average, "average," or "more than average" ascending. Despite the potential utility of these items to assess sports participation, we felt that these measures did not have enough breadth or objectivity to use as part of our assessment.

The chance to play sports, or even to engage in recreational physical activity, may not be available to many children. Prior literature has made a compelling

case to control for socioeconomic status (SES) when analyzing youth sport participation since lower rates of participation are tied to lower SES factors.[20,49] Participation in sports may incur costs for equipment, venue, and travel for not just the child playing, but also the transporting parent. The CBCL does not provide a direct way to assess a family's SES and indirect ways to measure it, such as by classifying parent employment by income, resulted in an ambiguous product. We would recommend that future studies along these lines assess SES as a covariate. Since SES may hinder children from participating in sports, we are interested in finding similar kinds of interventions to sports participation that could be mounted in primary care. If the association between sports participation and depressive symptoms means that children who play fewer sports go on to develop depressive symptoms, lack of sports participation could be one contributor to increased depression in low SES children. The causation may be direct, but is perhaps better explained by the positives that cluster with increased sports participation: increased socializing, healthy competition, and a tangible metric of success, among other things.

Every additional sport a child played was associated with a reduction in their Withdrawn/Depressed subscale score. The causation of this association is

difficult to establish, but either direction suggests a potential means of treatment. If a child is sad and withdrawn, they may seek out less recreation as a result. Conversely, fewer sports in a child's life may contribute to their sadness. Either way, increasing participation in sports or physical activity may alleviate these symptoms. It may be useful for clinicians to provide resources which facilitate this, such as links to coaches or leagues that provide sports play or discounted gym memberships.

Some have been concerned that an emphasis on screening and early detection of psychiatric symptoms in children may lead to over-diagnosis, or over-pathologizing normal emotions and behavior in children. Similar concerns have been raised about the increase in the identification of psychiatric illness in children over the past couple decades. It is not clear whether this increase is due to improved understanding of the development and symptoms of psychiatric illness, or an absolute increase in the incidence of new cases, or both. Aside from the question of new vs. existing cases, the prevalence rate measured by a study tends to be contingent on a variety of factors like sample size, sample demographics, and geographic location. [31,37] A meta-analysis of the prevalence of ADHD, the most common pediatric psychiatric condition, published in 2015

found a pooled estimate of 7.1% across the studies surveyed, which represents an increase of 1.9% from a similar study published eight years prior.[36,44] Most interestingly, this study noted a jump in the number of prevalence studies after the publication of a new DSM version, but did not find a statistically significant increase in ADHD prevalence between DSM versions III to 5.

For developmental disorders, such as autism, it may be fair to push back against the notion of a rising epidemic in the condition by noting that changing diagnostic criteria and new information about symptoms and onset merely allow us to capture behaviors and pathology that already existed under different names.[21,22] Increase in the prevalence of mood disorders like depression and anxiety can also fall into this category but may also take root from personal or sociocultural factors somewhat outside the ken of medicine.[33] For example, university students who reported satisfaction with their studies also reported lower scores on the DASS-42, a common screening tool to assess depression.[9] A study of mental disorder prevalence in Northern Ireland revealed a higher rate of PTSD relative to other countries which the authors connect to Northern Ireland's recent history of civil conflict. Research into the features of depression in black males reveals a disease intimately bound up with the historical experience of the

population.[35] Psychiatry makes extensive use of the modern tools of medicine and has in many ways been defined by it. The discovery of chlorpromazine seventy years ago provided a clarifying light to the murky bounds of mental illness and nosology has followed the lead of pharmacology to create a systematic framework that matches the rest of medical practice. But in working with the mind, psychiatry lays claim to a broader human quest for making sense of the feelings and circumstances that wash us like waves. The current work presented us with this question in the guise of determining the clinical cutoffs for our sample. Even for a well-validated test like the CBCL, there is still discussion over what constitutes a case. The children in this sample did not have a psychiatric diagnosis at the time of data collection, yet just over half presented with at least one subscale elevations. The usual clinical course for an elevation would be a follow-up appointment, with either the pediatrician or a specialist, possibly resulting in a diagnosis and treatment. This approach may help many children, but also requires admission to a network of labels, drugs, and associations. At least in the U.S.A., conventional medical care may prove challenging for families of lower means and possibly stigmatizing to both parents and children. Medical practitioners require a diagnosis to be associated with psychiatric treatment in order to bill medical insurance for their service.

The direction of our results suggests that recommending an increase in sports participation, like increasing the dose of a medication, might be an effective way to address depressive symptoms that is well-suited to early and low-impact intervention in children. Furthermore, it may be an excellent way to treat earlier the children who do not meet the criteria for a disease now, but will one day. If we as a community can develop more low-impact interventions such as these, we ensure that medicine can also include those children who may display impairment even as they fly under criteria or those with disorder that fades as they grow older. As we develop our diagnostic categories, refined as they are through the effective treatment of people, so too should we develop an understanding that no medicine, least of all psychiatry, occurs in a vacuum.

Conclusion:

Participation in fewer sports is associated with higher Withdrawn/Depressed subscale scores on the CBCL/6-18 in grade school children presenting for well child visits at an urban community health center serving a primarily Latino population. . This result suggests that sports participation could be protective of

mental health in school-age children and a realistic point of early intervention in primary care for underserved families.

REFERENCES

1. Andersen MH, Ottesen L, Thing LF. The social and psychological health outcomes of team sport participation in adults: An integrative review of research. *Scandinavian Journal of Public Health*. 2018:1403494818791405.

2. Anon. STATISTICAL BRIEF #349: Health Care Expenditures for the Five Most Common Children's Conditions, 2008: Estimates for U.S. Civilian Noninstitutionalized Children, Ages 0-17. Available at: https://meps.ahrq.gov/data_files/publications/st349/stat349.shtml [Accessed February 19, 2019].

3. Anon. Behavioral Health and Primary Care Integration | Bureau of Primary Health Care. Available at: https://bphc.hrsa.gov/qualityimprovement/clinicalquality/behavioralhealth/index.html [Accessed March 6, 2019].

4. Arnett AB, Pennington BF, Willcutt EG, DeFries JC, Olson RK. Sex differences in ADHD symptom severity. *Journal of Child Psychology and Psychiatry*. 2015;56(6):632–639.

5. Asarnow JR, Rozenman M, Wiblin J, Zeltzer L. Integrated Medical-Behavioral Care Compared With Usual Primary Care for Child and Adolescent Behavioral Health: A Meta-analysis. *JAMA Pediatrics*. 2015;169(10):929–937.

6. Aschenbrand SG, Angelosante AG, Kendall PC. Discriminant Validity and Clinical Utility of the CBCL With Anxiety-Disordered Youth. *Journal of Clinical Child & Adolescent Psychology*. 2005;34(4):735–746.

7. Babiss L, Gangwisch J. Sports Participation as a Protective Factor Against Depression and Suicidal Ideation in Adolescents as Mediated by Self-Esteem and Social Support. *Journal of Developmental & Behavioral Pediatrics*. 2009;30(5):376–384.

8. Badura P, Geckova AM, Sigmundova D, van Dijk JP, Reijneveld SA. When children play, they feel better: organized activity participation and health in adolescents. *BMC Public Health*. 2015;15:1090.

9. Bayram N, Bilgel N. The prevalence and socio-demographic correlations of depression, anxiety and stress among a group of university students. *Social Psychiatry and Psychiatric Epidemiol*ogy. 2008;43(8):667–672.

10. Belfer ML. Child and adolescent mental disorders: the magnitude of the problem across the globe. *Journal of Child Psychology and Psychiatry*. 2008;49(3):226–236.

11. Biederman J, Faraone SV. The Massachusetts General Hospital studies of gender influences on attention-deficit/hyperactivity disorder in youth and relatives. *The Psychiatric Clinics of North America.* 2004;27(2):225–232.

12. Biederman J, Monuteaux MC, Kendrick E, Klein KL, Faraone SV. The CBCL as a screen for psychiatric comorbidity in paediatric patients with ADHD. *Archives of Disease in Childhood.* 2005;90(10):1010–1015.

13. Bittner A, Egger HL, Erkanli A, et al. What do childhood anxiety disorders predict? *Journal of Child Psychology and Psychiatry*. 2007;48(12):1174–1183.

14. Bufferd SJ, Dougherty LR, Carlson GA, Rose S, Klein DN. Psychiatric Disorders in Preschoolers: Continuity From Ages 3 to 6. *The American Journal of Psychiatry*. 2012;169(11):1157–1164.

15. Costello EJ, Copeland W, Angold A. Trends in psychopathology across the adolescent years: What changes when children become adolescents, and when adolescents become adults? *Journal of Child Psychology and Psychiatry*. 2011;52(10):1015–1025.

16. Costello EJ, Mustillo S, Erkanli A, Keeler G, Angold A. Prevalence and Development of Psychiatric Disorders in Childhood and Adolescence. *Archives of General Psychiatry*. 2003;60(8):837.

17. Deaner RO, Geary DC, Puts DA, et al. A Sex Difference in the Predisposition for Physical Competition: Males Play Sports Much More than Females Even in the Contemporary U.S Hayward M, ed. *PLoS ONE*. 2012;7(11):e49168.

18. Den Heijer AE, Groen Y, Tucha L, et al. Sweat it out? The effects of physical exercise on cognition and behavior in children and adults with ADHD: a systematic literature review. *Journal of Neural Transmission (Vienna)*. 2017;124(Suppl 1):3–26.

19. Desha LN, Ziviani JM, Nicholson JM, Martin G, Darnell RE. Physical activity and depressive symptoms in American adolescents. *Journal of Sport and Exercise Psychology*. 2007;29(4):534–543.

20. Dollman J, Lewis NR. The impact of socioeconomic position on sport participation among South Australian youth. *Journal of Science and Medicine in Sport*. 2010;13(3):318–322.

21. Fombonne E. Epidemiology of Pervasive Developmental Disorders. *Pediatric Research*. 2009;65(6):591–598.

22. Fombonne E. Epidemiology of Autistic Disorder and Other Pervasive Developmental Disorders. *The Journal of Clinical Psychiatry*.:6.

23. Gísladóttir TL, Matthíasdóttir A, Kristjánsdóttir H. The effect of adolescents' sports clubs participation on self-reported mental and physical conditions and future expectations. *Journal of Sports Sciences*. 2013;31(10):1139–1145.

24. Hacker KA, Penfold RB, Arsenault LN, et al. Behavioral Health Services Following Implementation of Screening in Massachusetts Medicaid Children. *Pediatrics*. 2014;134(4):737–746.

25. Kanters MA, Bocarro JN, Edwards MB, Casper JM, Floyd MF. School sport participation under two school sport policies: comparisons by race/ethnicity, gender, and socioeconomic status. *Annals of Behavioral Medicine*. 2013;45 Suppl 1:S113-121.

26. Kapphahn CJ, Morreale MC, Rickert VI, Walker LR. Financing Mental Health Services for Adolescents: A Position Paper of the Society for Adolescent Medicine. *Journal of Adolescent Health*. 2006;39(3):456–458.

27. Kessler RC, Amminger GP, Aguilar-Gaxiola S, et al. Age of onset of mental disorders: A review of recent literature. *Current Opinion in Psychiatry*. 2007;20(4):359–364.

28. Korczak DJ, Madigan S, Colasanto M. Children's Physical Activity and Depression: A Meta-analysis. *Pediatrics*. 2017;139(4).

29. Mangerud WL, Bjerkeset O, Lydersen S, Indredavik MS. Physical activity in adolescents with psychiatric disorders and in the general population. *Child and Adolescent Psychiatry and Mental Health*. 2014;8:2.

30. McNamee R. Confounding and confounders. *Occupational and Environmental Medicine*. 2003;60(3):227–234.

31. Merikangas KR, He J, Burstein M, et al. Lifetime Prevalence of Mental Disorders in U.S. Adolescents: Results from the National Comorbidity Survey Replication–Adolescent Supplement (NCS-A). *Journal of the American Academy of Child & Adolescent Psychiatry*. 2010;49(10):980–989.

32. Moeijes J, van Busschbach JT, Bosscher RJ, Twisk JWR. Sports participation and psychosocial health: a longitudinal observational study in children. *BMC Public Health*. 2018;18(1):702.

33. Mojtabai R, Olfson M, Han B. National Trends in the Prevalence and Treatment of Depression in Adolescents and Young Adults. *Pediatrics*. 2016;138(6):e20161878.

34. Nelson MC, Gordon-Larsen P, Adair LS, Popkin BM. Adolescent physical activity and sedentary behavior: Patterning and long-term maintenance. *American Journal of Preventive Medicine*. 2005;28(3):259–266.

35. Perkins DE. Challenges to Traditional Clinical Definitions of Depression in Young Black Men. *American Journal of Men's Health*. 2014;8(1):74–81.

36. Polanczyk G, de Lima MS, Horta BL, Biederman J, Rohde LA. The worldwide prevalence of ADHD: a systematic review and metaregression analysis. *The American Journal of Psychiatry*. 2007;164(6):942–948.

37. Roberts RE, Attkisson CC, Rosenblatt A. Prevalence of Psychopathology Among Children and Adolescents. *The American Journal of Psychiatry*. 1998;155(6):715–725.

38. Sabiston CM, O'Loughlin E, Brunet J, et al. Linking depression symptom trajectories in adolescence to physical activity and team sports participation in young adults. *Preventive Medicine*. 2013;56(2):95–98.

39. Salk RH, Hyde JS, Abramson LY. Gender Differences in Depression in Representative National Samples: Meta-Analyses of Diagnoses and Symptoms. *Psychological Bulletin*. 2017;143(8):783–822.

40. Savageau JA, Keller D, Willis G, et al. Behavioral Health Screening among Massachusetts Children Receiving Medicaid. *The Journal of Pediatrics*. 2016;178:261–267.

41. Spencer AE, Plasencia N, Sun Y, et al. Screening for Attention-Deficit/Hyperactivity Disorder and Comorbidities in a Diverse, Urban Primary Care Setting. *Clinical Pediatrics.* 2018;57(12):1442–1452.

42. Telama R, Yang X, Viikari J, et al. Physical activity from childhood to adulthood: A 21-year tracking study. *American Journal of Preventive Medicine*. 2005;28(3):267–273.

43. Thomas M. Achenbach. *Achenbach System of Empirically Based Assessment.* Available at: www.aseba.org [Accessed January 30, 2019].

44. Thomas R, Sanders S, Doust J, Beller E, Glasziou P. Prevalence of Attention-Deficit/Hyperactivity Disorder: A Systematic Review and Meta-analysis. *Pediatrics*. 2015;135(4):e994–e1001.

45. Toselli S, Belcastro MG. Participation in sports, body composition, and fitness characteristics in children according to ethnic background. *Scandinavian Journal of Medicine and Science in Sports.* 2017;27(12):1913–1926.

46. Van Tuyckom C, Scheerder J, Bracke P. Gender and age inequalities in regular sports participation: a cross-national study of 25 European countries. *Journal of Sports Sciences*. 2010;28(10):1077–1084.

47. Vella SA, Cliff DP, Magee CA, Okely AD. Associations between sports participation and psychological difficulties during childhood: a two-year follow up. *Journal of Science and Medicine in Sport* 2015;18(3):304–309.

48. Vella SA, Swann C, Allen MS, Schweickle MJ, Magee CA. Bidirectional Associations between Sport Involvement and Mental Health in Adolescence. *Medicine and Science in Sports and Exercise*. 2017;49(4):687–694.

49. Walters S, Barr-Anderson DJ, Wall M, Neumark-Sztainer D. Does Participation in Organized Sports Predict Future Physical Activity for Adolescents from Diverse Economic Backgrounds? *Journal of Adolescent Health*. 2009;44(3):268–274.

50. Wijtzes AI, Jansen W, Bouthoorn SH, et al. Social inequalities in young children's sports participation and outdoor play. *The International Journal of Behavioral Nutrition and Physical Activity*. 2014;11:155.

51. Zucker KJ. Epidemiology of gender dysphoria and transgender identity. *Sexual Health*. 2017;14(5):404.

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