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Sports participation and academic performance: Evidence from the National Longitudinal Study of Adolescent Health

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ABSTRACT

It has been argued that high school sports participation increases motivation and teaches teamwork and self-discipline. While several studies have shown that students who participate in athletic activities perform better in school than those who do not, it is not clear whether this association is a result of positive academic spillovers, or due to the influence of unobservables. Using data from the National Longitudinal Study of Adolescent Health and a variety of statistical techniques designed to distinguish between these hypotheses, we examine the effect of sports participation on several measures of academic performance. Our results provide only limited evidence that sports participation leads to enhanced academic performance.

"Sports do not build character. They reveal it."
– John Wooden, UCLA Head Basketball Coach

1. Introduction

The effect of participating in athletics as a youth on academic performance is theoretically ambiguous. Participation may reduce the time available for studying and learning. Conversely, it has been argued that sports participation increases students' motivation and teaches teamwork and self-discipline, resulting in positive academic spillovers.

Studies have, in fact, shown that high school athletes receive better grades (Darling, Caldwell, & Smith, 2005; Eccles & Barber, 1999; Eitle & Eitle, 2002; Silliker & Quirk, 1997), have higher educational and occupational aspirations (Darling et al., 2005; Marsh & Kleitman, 2002; Otto & Alwin, 1977; Sabo, Melnick, & Vanfossen, 1993), spend more time doing homework (Marsh & Kleitman, 2002), and have a more positive attitude towards school (Darling et al., 2005; Eccles & Barber, 1999) than non-athletes. However, these associations may simply be a reflection of unobservables correlated with both sports participation and the outcome under study as opposed to causal in nature. To our knowledge, to date there has been no attempt in the empirical literature to distinguish between these hypotheses.[2]

Here we use data from the National Longitudinal Study of Adolescent Health to examine the relationship between sports participation and several measures of adolescent academic performance including grade point average (GPA), whether the respondent reported having difficulty with completing homework and paying atten-

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[2] Work by economists has focused on estimating the effects of sports participation on educational attainment as opposed to grades or other measures of academic performance. See, for instance, Long and Caudill (1991), Barron, Ewing and Waddell (2000), Eide and Ronan (2001), and Pfeifer and Cornelißen (2010).

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tion in class, and whether the student reported having aspirations to attend college. Controlling for a wide set of individual- and family-level observables, ordinary least squares estimates suggest that sports participation is associated with an increase in GPA of approximately 0.17 points. In contrast, fixed effects and instrumental variables estimates of the relationship between sports participation and grades are usually much smaller in magnitude or are of the opposite sign. This pattern of results suggests that the positive association between sports participation and academic performance can, in large part, be explained by individual-level unmeasured heterogeneity as opposed to academic spillovers.

2. Background

Most high school students in the United States participate in athletics. For instance, in 2003, fully 57.6% of 9th through 12th graders reported playing at least one team sport (U.S. Centers for Disease Control and Prevention 2004). Moreover, there is evidence that high school athletic programs are expanding. According to The National Federation of State High School Associations, the number of high school athletes has been growing for the past 17 years.

Participation in structured athletic activities is said to promote a wide range of "social, physical, and intellectual skills," leading to better classroom performance (Eccles, Barber, Stone, & Hunt, 2003, p. 866). In fact, there is a fair amount of evidence to support this claim. As noted above, high school athletes on average perform better academically than non-athletes, an association that persists even after controlling for factors such as race, ethnicity, and family background variables. Many researchers in this area have concluded that the link between athletics and academic performance is causal.

However, much of the empirical work in this area has treated sports participation as exogenously determined. As noted by Eccles et al. (2003), this empirical strategy risks confusing the effect of participation with unobservable (from the standpoint of the researcher) "characteristics of the youth who sign up for and stay in the programs" (p. 885).

Methods for distinguishing between the effects of unobservables and athletics participation, of course, exist. For instance, using survey data from High School and Beyond, Eide and Ronan (2001) examined the relationship between athletic participation and educational attainment (as opposed to a contemporaneous measure of academic performance such as grades), accounting for the influence of unobservables through instrumental variables estimation. They found that the effect of sports participation varied according to the gender (and the race/ethnicity) of the athlete. Barron et al. (2000) used a similar methodology and concluded that male high school athletes went on to receive more years of education than non-athletes.

Another approach to the problem of unobservables is to more fully exploit the longitudinal nature of many data sources. For instance, Eccles and Barber (1999) observed a sample of Michigan high school students when they were in the 10th (period $t-1$) and 12th grades (period t).[3] They estimated the following equation:

$$y_{it} = \pi_0 + \pi_1' X_{it-1} + \pi_2\, Sports_{it-1} + \pi_3 y_{it-1} + \varepsilon_{it}, \qquad (1)$$

where y_{it} is an outcome variable such as GPA or attitudes toward school, and $Sports_{it-1}$ indicates if the respondent participated in high school athletics. In addition to a standard set of controls, represented by the vector X_{it-1}, Eccles and Barber (1999) included the lag of the outcome variable on the right hand side of the estimating equation.

This specification was designed to deal with the problem of unobservables. However, underlying it is the implicit assumption that 10th grade athletic participation affects the change in academic performance from 10th to 12th grade. In other words, failure to reject the hypothesis $\pi_2 = 0$ does not rule out the possibility that participation in school athletics provides a one-time boost to the level of academic performance. Moreover, if there are unobserved factors correlated with both the participation decision and with the change in academic performance over the period examined, this model will produce a biased estimate of π_2. Eccles and Barber (1999) concluded that sports participation leads to better academic performance, but given these issues their result should be viewed as tentative at best.

In summary, many of the previous empirical studies examining the effect of sports participation on grades and other contemporaneous measures of academic performance failed to adequately control for the endogeneity of sports participation. Building on the work of economists such as Eide and Ronan (2001) who estimated the effect of playing varsity sports on educational attainment, our study contributes to the literature by more carefully controlling for unmeasured heterogeneity with the goal of separating causal links from spurious effects due to individual-level unobservables.

3. Data and methods

Our data come from the National Longitudinal Study of Adolescent Health, conducted by the Carolina Population Center at the University of North Carolina at Chapel Hill. The Adolescent Health data collection effort began with the identification of more than 26,000 high schools from across the United States. Eighty were selected from this population, and most were matched with a junior high or middle school from the same community, bringing the total number of participating schools to 132. From the student rosters of these 132 schools, a core sample was randomly chosen to be administered the Adolescent Health Wave I (baseline) in-home survey, which was completed by 20,746 adolescents between April and December of 1995. A Follow-up in-home survey was administered approximately 1 year later (between April and August of 1996).[4]

[3] See also Lipscomb (2007) who used a fixed effects approach to examine the effect of sports participation on college aspirations and math and science test scores.

[4] Further information regarding the Adolescent Health data collection effort is available from a variety of sources. See, for instance, Harris et al. (2006).

Although the Adolescent Health study did not administer formal achievement tests such as are available in the National Education Longitudinal Survey of 1988, the data contain a number of measures of academic performance. Specifically, respondents to the in-home surveys were asked about their grades in math, science, history, and English "during the last grading period."[5] In addition, respondents were asked if they had difficulty paying attention in class, difficulty completing their homework on time, and whether they aspired to go to college.

In the analysis below, our primary focus is on the relationship between sports participation and grades as measured by a respondent's GPA in math and English. We also experiment with a comprehensive measure of GPA that includes reported grades in history and science. Betts and Morrell (1999, p. 269) note that "GPA reflects human capital acquisition at a time when young adults are close to permanent entry into the labor force," and, in fact, there is a fair amount of evidence to suggest that high school GPA is an important determinant of earnings and academic performance in college.

In addition to GPA, we employ three more outcome variables, each dichotomous. The first is equal to 1 if the respondent reported having difficulty paying attention in class more than once a week, and equal to 0 otherwise; the second is equal to 1 if the respondent reported having difficulty completing his or her homework more than once a week, and equal to 0 otherwise[6]; and the third is equal to 1 if the respondent reported having strong aspirations to go to college, and equal to 0 otherwise.[7] The claim that sports participation leads to better academic performance is often buttressed by empirical studies using outcomes similar to these (see, for instance, Darling et al., 2005; Marsh & Kleitman, 2002).

Sports participation is based on how often the respondent played "an active sport, such as baseball, softball, basketball, soccer, swimming, or football" during the week prior to being interviewed. Possible answers were: "not at all," "1 or 2 times," "3 or 4 times," and "5 or more times." At Wave I, 82% of male respondents to the in-home survey reported playing an active sport at least one or two times in the past week, as compared to 62% of female respondents. Thirty-eight percent of respondents who played an active sport limited their participation to one or two times per week; 26% reported playing an active sport three or four times in the last week; and 36% reported playing an active sport five or more times.

One of the limitations of using the Adolescent Health in-home surveys is that they contain no information on whether the respondent was a member of an official school team. To date, most researchers have focused on school-based sports participation, which raises the issue of whether our results can be compared to those of earlier studies. However, the Adolescent Health in-home surveys did ask about daily sports participation during the school year, which can be thought of as a proxy for team membership.[8]

Our formal analysis begins by comparing the academic performance of Wave I in-home survey respondents who played an active sport with the performance of those who answered "not at all" through the creation of three dichotomous variables: *Sports12*, *Sports34*, and *Sports5*. The first of these variables is equal to 1 for respondents who played an active sport in the week prior to being interviewed 1 or 2 times, and is equal to 0 otherwise; the second is equal to 1 if the respondent played an active sport 3 or 4 times, and is equal to 0 otherwise; and the third is equal to 1 if the respondent played 5 or more times, and is equal to 0 otherwise. Specifically, we estimate the following equation:

$$y_i = \pi_0 + \pi_1' X_{i_i} + \pi_2 Sports12_i + \pi_3 Sports34_i + \pi_4 Sports5_i + \varepsilon_i, \quad (2)$$

where Y_i is the outcome, X_i is a vector of controls,[9] and ε_i is a random error term. A cross-section identification strategy of the form described in Eq. (2) has been most commonly used in the sports-academics literature.

Although the Adolescent Health Wave I in-home survey contains a wide variety of potential controls, this estimation strategy is nevertheless subject to the problem of unobservables described above. If, for example, students who choose to participate in sports are more highly motivated or disciplined, then the identification assumption of the above model, $E(\varepsilon_i|Sports_i) = 0$, will be violated. In order to account for unobservables, we utilize data from both the Wave I and Wave II in-home surveys of the Adolescent

[5] The Add Health survey asked, "[a]t (the most recent grading period/last grading period in the spring), what was your grade in ___?" Possible responses were: A, B, C, and D or lower. We calculated a cumulative GPA and a GPA in math and English by assigning 4.0 for a grade of A, 3.0 for a grade of B, 2.0 for a grade of C, and 0.5 for a grade of D or lower.

[6] Students were asked, "how often have you had trouble paying attention in school?" and "how often have you had trouble completing your homework?" Possible answers to these questions were: "never," "just a few times," "about once a week," "almost every day," and "everyday."

[7] Students who answered "5" to the following question were defined as having had strong aspirations to attend college: "On a scale of 1 to 5, where 1 is low and 5 is high, how much do you want to go to college?".

[8] Almost 39% of males who completed the Adolescent Health Wave I in-home survey during the school year played "an active sport, such as baseball, softball, basketball, soccer, swimming, or football" 5 or more times per week. Using data from 2003 through 2005 Johnston, Delva, and O'Malley (2007) found that 37% of male 8th, 10th and 12th graders participated in interscholastic or varsity sports. That these figures are so similar suggests that focusing on males who completed the Adolescent Health Wave I in-home survey during the school year and played an active sport 5 or more times per week is appropriate when comparing our results to those of previous researchers. However, only 18% of females who completed the Adolescent Health Wave I in-home survey played an active sport at least 5 times per week, while Johnston et al. (2007) found that 33% of female 8th, 10th and 12th graders participated in interscholastic or varsity sports.

[9] These controls include demographic characteristics (age, race, region, urbanicity, log household income, grade in school, parental educational attainment, and whether the respondent was from a single-parent household), school characteristics (average class size, whether the respondent's school was public, percent of the students enrolled in college preparatory courses, and school size), parental involvement in education (whether the parent moved to the neighborhood because of school quality, whether the parent was a member of the PTA, parental attitudes about the adolescent's college attendance, and number of family dinners per week), physical and mental health measures (body mass index, an indicator of depression, having a friend or family member who attempted suicide, self-report of physical health, and religious attendance), and cognitive and puberty controls (Add Health PPVT score and a puberty index).

Health and modify (2) to include individual fixed effects (denoted v_i):

$$y_{it} = \pi_0 + \pi_1' X_{it_i} + \pi_2 Sports12_{it} + \pi_3 Sports34_{it} + \pi_4 Sports5_{it} + v_i + \varepsilon_{it}, \quad (3)$$

Although the inclusion of individual fixed effects will control for time-invariant unobservables, if the decision to participate in sports is correlated with, for instance, a renewed interest in academics, then (3) will also produce a biased estimate of sports participation. Alternatively, it may be that the choice to participate is based, at least in part, on an assessment of how difficult or demanding a class, or a set of classes, will be.[10] In either case, the identification assumption in Eq. (3), $E(\varepsilon_{it} - \varepsilon_{it-1} | Sports_{it} - Sports_{it-1}) = 0$, is violated.

An alternative estimation strategy is to identify an instrument, Z_i, that is correlated with sports participation, but uncorrelated with the error term of (2), ε_i. Specifically, if the decision to participate in sports is given by

$$Sports_i = \alpha_0 + \alpha_1' X_i + \alpha_2 Z_i + u_i, \quad (4)$$

then an alternative estimate of the effect of sports participation can be obtained using instrumental variables (2SLS) estimation. The advantage of this strategy is that it produces a consistent estimate of the effect of sports participation even if the unobservables in question vary between the baseline and follow-up interview. However, it relies on being able to identify an appropriate instrument.

Following Eide and Ronan (2001), we use height as our instrument in the 2SLS analysis below. Eide and Ronan noted that height is an asset in many sports (e.g., basketball and volleyball), but their review of the existing literature produced little reason to suspect a direct relationship between height and educational attainment or productivity.[11] More recently, Persico, Postlewait, and Silverman (2004) found evidence that adolescent height was positively related to earnings as an adult. However, because the adolescent height premium persisted even after controlling for reading and math test scores at age seven, the authors argued that it was not a reflection of native intelligence or early cognitive development (Persico et al., 2004, pp. 1037–1039). In contrast, controlling for athletic participation in high school reduced their estimate of the height premium substantially.[12] Persico et al. (2004, p. 1041) speculated that participation in high school athletics may "facilitate the accumulation of productive human capital like social adaptability." If height is related to productivity (and therefore earnings) through school athletics as opposed to cognitive development or intelligence, then it is a valid instrument for our purposes.

Using the same data set as did Persico et al. (2004), Case and Paxson (2008) came to the opposite conclusion.[13] Specifically, they found that reading and math tests scores at ages seven and eleven explained a large portion of the adolescent height premium. Their result raises the possibility that there exists a direct relationship between height and cognitive ability. In order to ensure that our instrument is uncorrelated with the error term of (2), we include the respondent's score on the Adolescent Health Picture Vocabulary Test, an abridged version Peabody Picture Vocabulary Test (PPVT), in the vector X_i. Case and Paxson (2008) used the PPVT as an alternative measure of cognitive ability. They found that PPVT scores were strongly related to height using data from the Fragile Families and Child Wellbeing Study.[14]

Puberty represents another path through which height could be correlated with unmeasured determinants of academic performance. The onset of puberty is associated with growth spurts as well as hormonal changes that increase sexual awareness. Such hormonal changes could affect classroom concentration and academic performance. We include several observed measures of puberty in X_i. For females, these measures include the degree of breast development and body curves, and the onset of menstruation. For males, we include variables capturing the thickness of underarm and facial hair, and depth of voice.

4. Results

Table 1 presents estimates of the effect of sports participation on GPAs in math and English. OLS estimates suggest that sports participation leads to higher grades and that this benefit is positively related to frequency of participation. Specifically, playing an active sport one or two times per week is associated with a 0.109 increase in math and English GPAs; playing three to four times per week is associated with a 0.151 increase; and playing five or more times is associated with a 0.187 increase (column 1, Panel I).

Eide and Ronan (2001) found that that the estimated effect of sports participation on educational attainment differed dramatically by race and ethnicity. In columns (3), (5), and (7) of the top panel of Table 1 we test for these types of differences with regard to grades. The results suggest that the boost to math and English GPAs associated with playing sports is greater for whites as compared to blacks and Hispanics.

As noted, Wave I of the Adolescent Health in-home survey was conducted between the months of April and December. Because of this timing, a large number of respondents (63.7%) were interviewed during their summer recess and were asked to provide grades from the

[10] For instance, students may be more likely to devote time to sports when they are taking less-demanding classes.

[11] For instance, they noted that Hamermesh and Biddle (1994) showed that height was uncorrelated with earnings after controlling for weight.

[12] Specifically, Persico et al. (2004) found that the estimated effect of height on wages fell by 38% and became statistically insignificant when controls for athletic participation and school clubs were added to the model. Athletic participation was associated with nearly a 17% increase in adult wages, whereas participation in other high school clubs was associated with a 10% increase.

[13] Persico et al. (2004) used British data from the National Child Development Survey (NCDS) and U.S. data from the National Longitudinal Survey of Youth. Case and Paxson (2008) also drew on data from the NCDS.

[14] The Peabody Picture Vocabulary Test (PPVT) measures verbal comprehension and vocabulary. The test is conducted by an interviewer who reads a word to a respondent and then has the respondent choose among four illustrations to determine the picture that best fits the word. The PPVT consists of 78 items (Harris & Thomas, 2002). Adolescent Health respondents were administered 39 of these 78 items.

Table 1
OLS and individual fixed effects estimates of relationship between sports involvement and Math-English GPA[a,b].

	All		White		Blacks		Hispanics		School year		Same month	
	OLS (1)	FE (2)	OLS (3)	FE (4)	OLS (5)	FE (6)	OLS (7)	FE (8)	OLS (9)	FE (10)	OLS (11)	FE (12)
Panel I: OLS and FE estimates, by race												
Sports12	0109*** (0.029)	0046** (0.018)	0122*** (0.033)	0027 (0.026)	0081* (0.046)	0057 (0.039)	0120 (0.078)	0075* (0.041)	0133** (0.066)	0033 (0.035)	0149*** (0.054)	0090** (0.045)
Sports34	0151*** (0.026)	0037* (0.024)	0196*** (0.040)	0013 (0.036)	0150*** (0.052)	0092** (0.045)	0009 (0.060)	0054 (0.047)	0156*** (0.055)	0026 (0.040)	0154*** (0.051)	0027 (0.050)
Sports5	0187*** (0.028)	0041* (0.024)	0237*** (0.038)	0052 (0.033)	0154*** (0.049)	0012 (0.056)	0110 (0.079)	0049 (0.046)	0172*** (0.058)	0074 (0.053)	0157** (0.062)	0024 (0.046)
N	11,261	11,261	6043	6043	2521	2521	1741	1741	2860	2860	2558	2558
	All		Whites		Blacks		Hispanics		School year		Same month	
	Males (1)	Females (2)	Males (3)	Females (4)	Males (5)	Females (6)	Males (7)	Females (8)	Males (9)	Females (10)	Males (11)	Females (12)
Panel II: FE estimates, by gender and race												
Sports12	0003 (0.029)	0072*** (0.022)	−0008 (0.041)	0050 (0.035)	0080 (0.072)	0055 (0.042)	−0063 (0.080)	0159*** (0.049)	0024 (0.059)	0031 (0.048)	0035 (0.073)	0119** (0.054)
Sports34	0015 (0.034)	0045 (0.030)	−0022 (0.051)	0042 (0.044)	0146* (0.079)	0050 (0.057)	−0025 (0.077)	0086 (0.078)	−0028 (0.069)	0065 (0.057)	−0030 (0.081)	0066 (0.061)
Sports5	0027 (0.033)	0038 (0.023)	0050 (0.047)	0037 (0.043)	0054 (0.075)	−0007 (0.077)	−0021 (0.074)	0058 (0.072)	0030 (0.079)	0105 (0.066)	−0005 (0.079)	−0018 (0.056)
N	5513	5748	2970	3073	1177	1344	859	882	1419	1441	1230	1328

Notes: OLS estimates are from unweighted regressions based on Wave I of the National Longitudinal Study of Adolescent Health. Fixed effects estimates are from unweighted regressions based on data from Waves I and II of the National Longitudinal Study of Adolescent Health. Standard errors corrected for clustering at the school level are in parentheses.

[a] Omitted category is composed of individuals who did not participate in active sports.

[b] OLS models include controls for demographic characteristics, school characteristics, parental school involvement, physical and mental health, PPVT score, and puberty controls.

* Statistically significant at the 10% level.

** Statistically significant at the 5% the level.

*** Statistically significant at the 1% level.

previous academic year. In contrast, respondents were asked about their sports participation "last week." By restricting the sample to respondents who were interviewed while school was in session, we can focus on the effect of engaging in an active sport while simultaneously trying to meet academic demands. Although, one might argue that participating in sports during the school year as opposed to summer recess would be more likely to take time away from productive studying, the results were qualitatively unchanged when the sample was restricted in this fashion (column 9). Once again, the largest estimated effect is for those playing sports at least five times per week, consistent with the results from studies that focused on school-based sports involvement.

In sum, the OLS results presented in the top panel of Table 1 are consistent with the previous literature (Darling et al., 2005; Camp 1990; Eccles & Barber, 1999; Eitle & Eitle, 2002; Marsh & Kleitman, 2002; Otto & Alwin, 1977; Sabo et al., 1993; Silliker & Quirk, 1997), and, if naively interpreted, suggest an important role for sports participation in the acquisition of human capital. However, if unmeasured motivation, future-orientedness, or self-discipline is correlated with both academic performance and sports participation, then policies based on results such as these may be misguided. The fixed effect estimations presented in the even-numbered columns of the top panel of Table 1 attempt to control for unmeasured heterogeneity.[15]

The results suggest that adding individual fixed effects to control for the influence of unobservables produces estimates that are 58–78% smaller than the corresponding OLS coefficients. For whites and Hispanics, adding fixed effects to the model produces estimates that are statistically indistinguishable from 0; for blacks, there remains some evidence that sports participation leads to higher grades.

Many school sports are seasonal. For instance, football is typically played in the fall, while baseball is typically played in the spring. To ensure that the observed variation in sports participation between Waves I and II is not being driven by the timing of the in-home surveys, we restricted the sample to respondents who were interviewed when school was in session, and to respondents who were interviewed during the same month in both waves. The results, which are presented in the top panel of Table 1 in columns (11) and (12), are similar to the results for the full sample. The fixed effects estimates are consistently smaller than the corresponding OLS estimates and are, with one exception, statistically insignificant at conventional levels.

The bottom panel of Table 1 presents fixed effects estimates of the relationship between sports participation and Math-English GPAs by gender. There is little evidence in this table to support the claim that among males sports involvement affects the grades. However, the fixed effects estimates for females are occasionally positive and statistically significant. For instance, engaging in active sports 1 or 2 times per week is associated with a 0.072 increase in Math-English GPAs; engaging in active sports 3 or 4 times per week is associated with a (statistically insignificant) 0.045 increase.

In Table 2 we turn to alternative measures of academic performance: comprehensive grade point average (which includes grades in math, English, science and history), aspirations to attend college, difficulty paying attention in class, and difficulty completing homework. The fixed effects results using comprehensive GPA as a measure of grade performance are similar to those obtained using Math-English GPA: sports participation is associated with a 0.04–0.05 point increase in GPA for females, but not males. In addition, sports participation is associated with a reduction in the probability that male respondents reported having difficulty completing their homework, and engaging in sports 5 or more times per week is associated with an increase in the probability that both males and females aspired to go to college. However, after controlling for individual fixed effects, there is no evidence that sports participation is associated with difficulty paying attention in class.

Taken together, the results in Tables 1 and 2 provide evidence of a relationship between sports involvement and academic performance, but suggest that OLS substantially overstates the magnitude of this relationship. However, there are at least three potential problems with the fixed effects estimates discussed above. First, they are subject to omitted variable bias if the omitted variable in question is correlated both with changes in sports participation from Wave I to Wave II and changes in academic performance over the same period. Second, if adolescents strategically time when they participate in sports (for instance, when the cost of doing so is lowest in terms of diminished academic performance) this could also be a source of bias. Finally, it is likely that some portion of the observed changes in sports participation from Wave I to Wave II is due to measurement error. It has been shown that measurement error of this type leads to estimates that are biased toward zero.[16] In light of these potential problems with the fixed effects estimates presented in Tables 1 and 2, we pursue an instrumental variables strategy.

Table 3 presents 2SLS estimates of the relationship between sports participation (measured as a 0–1 variable) and academic performance for males and females combined and by gender.[17] For comparison, OLS estimates based on the 2SLS samples are also presented.

[15] The fixed effects estimates do not include additional covariates. Models that included those controls that exhibited variation between the Wave I and II surveys produced virtually identical estimates, which are available upon request. Identification of the fixed effects model comes from within-person variation in sports involvement and GPAs. There is substantial within-person variation in academic performance and sports involvement between the Wave I and II in-home surveys. Over 35% of the sample had GPA changes of more than 0.5 points between the waves, and 18.4% had GPA changes of over 1.0 points. Moreover, 58% of adolescents changed their frequency of involvement in athletic activities between interviews.

[16] Freeman (1984) showed that even modest random measurement error in the cross-section can lead to panel data estimates that are biased towards zero "by substantial amounts" (p. 3).

[17] Regressions using the full sample include a dichotomous variable equal to 1 if the respondent was female and equal to 0 otherwise. The inclusion of this variable in the first stage should control for any differences in the underlying propensity of males and females to engage in sports, while its inclusion in the second stage should control for any differences in academic ability between males and females.

Table 2
Fixed effects estimates of relationship between sports involvement and other schooling outcomes for by gender[a].

	Comprehensive GPA			Aspire to attend college			Difficulty paying attention in class			Difficulty completing homework		
	All (1)	Males (2)	Females (3)	All (4)	Males (5)	Females (6)	All (7)	Males (8)	Females (9)	All (10)	Males (11)	Females (12)
Sports12	0.037** (0.019)	0.001 (0.030)	0.057** (0.022)	0.015* (0.008)	0.014 (0.013)	0.015 (0.010)	0.004 (0.010)	−0.009 (0.017)	0.011 (0.010)	−0.025*** (0.010)	−0.039** (0.016)	−0.017* (0.010)
Sports34	0.038** (0.022)	0.017 (0.034)	0.046* (0.027)	0.009 (0.010)	0.011 (0.014)	0.008 (0.014)	−0.017 (0.011)	−0.029 (0.017)	−0.008 (0.015)	−0.018 (0.011)	−0.026 (0.018)	−0.017 (0.013)
Sports5	0.047** (0.022)	0.030 (0.032)	0.048* (0.029)	0.035*** (0.010)	0.041*** (0.013)	0.028** (0.013)	−0.011 (0.011)	−0.018 (0.019)	−0.010 (0.014)	−0.022* (0.012)	−0.039** (0.018)	−0.007 (0.016)
N	7885	3807	4078	14,728	7186	7542	13,268	6435	6833	12,659	6093	6566

Notes: Fixed effects estimates are from unweighted regressions based on data from Waves I and II of the National Longitudinal Study of Adolescent Health. Standard errors corrected for clustering at the school level are in parentheses.
[a] Omitted category is composed of individuals who did not participate in active sports.
* Statistically significant at the 10% level.
** Statistically significant at the 5%.
*** Statistically significant at the 1% level.

In keeping with Eide and Ronan's (2001) findings, height is a strong first-stage predictor of sports participation. In the full sample, an extra inch of height is associated with a 0.6–0.7 percentage point increase in sports participation. When the sample is restricted to males, the estimated effect of height on the probability of sports participation is somewhat smaller (0.3–0.4 percentage points); when the sample is restricted to females, the estimated effect of height on participation is comparable to that in the full sample.

The *F*-statistics for the null hypothesis that height is unrelated to sports participation range from 38.6 to 44.5 in the pooled samples, clearly satisfying the instrument relevance standards proposed by Staiger and Stock (1997). However, when males and females are treated separately, the *F*-statistics for height fall sharply. Using the correction proposed by Cruz and Moreira (2005), we found that conditional likelihood ratio tests generate confidence intervals of the 2SLS estimates that are generally larger than those obtained using the standard Wald test, especially for the samples separated by gender. However, the findings are qualitatively similar.[18]

The second-stage results are generally consistent with individual fixed effects estimates reported above. Although OLS estimates indicate a strong positive relationship between sports participation and academic performance, the 2SLS estimates, while imprecise, suggest that this relationship is driven by unmeasured heterogeneity.[19] For instance, the 2SLS estimates of the effect of sports participation on grades are always negative (but never significant). Moreover, the 2SLS estimates suggest that sports participation actually leads to greater difficulty paying attention in class and completing homework. In fact, only in the case of college aspirations do we find any evidence that sports participation leads to enhanced academic performance. However, these latter estimates are never statistically significant. In summary, the instrumental variables estimates, like the individual fixed effects estimates, provide very little evidence of positive academic spillovers associated with playing an active sport.[20]

18 Because height is the sole instrument, we cannot conduct tests of overidentifying restrictions. However, when height was included as an additional regressor in OLS models such as those presented in Table 2, its coefficient was, with only one exception (difficulty paying attention in class), statistically insignificant. We also regressed the residuals from the OLS academic performance models on height. There was no evidence that height was significantly correlated with the residuals. These results, in conjunction with those presented by Eide and Ronan (2001), suggest that height is a valid instrument.

19 Although the 2SLS estimates indicate that OLS estimates overstate the academic effects of sports participation, they are not sufficiently precise to rule out the possibility of positive schooling spillovers. However, the fact that the 2SLS and OLS estimates often are of the opposite sign suggests that the OLS estimates overstate the benefits of sports involvement.

20 2SLS estimates of the effect of playing a sport at least 5 times per week produced some evidence that males who engage in a rigorous exercise regime have higher grades and higher college aspirations than their counterparts who do not participate in sport; however the 2SLS estimates, although positive, are never statically significant. It is possible that a better measure of varsity sports participation would yield more precise 2SLS estimates.

Table 3
2SLS Estimates of relationship between sports involvement and schooling outcomes[a].

	Math-English GPA		Comprehensive GPA		College aspirations		Difficulty paying attention		Difficulty completing homework	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)	OLS (9)	2SLS (10)
Panel I: all										
Sports	0.134*** (0.018)	−0.420 (0.348)	0.130*** (0.017)	−0.123 (0.292)	0.052*** (0.008)	0.087 (0.166)	−0.015** (0.007)	0.386** (0.179)	−0.031*** (0.006)	0.170 (0.128)
Wald 95% CI	[−1.10, 0.262]	[−0.695, 0.449]	[−0.240, 0.413]	[0.035, 0.739]	[−0.080, 0.420]					
Conditional likelihood ratio 95% CI	[−1.22, 0.250]	[−0.777, 0.470]	[−0.251, 0.431]	[0.063, 0.800]	[−0.075, 0.460]					
p-Value on height in OLS regression	*p* = 0.11		*p* = 0.38		*p* = 0.84		*p* = 0.03		*p* = 0.10	
First-stage equation results										
Height (in.)		0.006*** (0.001)		0.007*** (0.001)		0.006*** (0.001)		0.006*** (0.001)		0.006*** (0.001)
F-Stat on instrument		*F* = 53.2***		*F* = 50.7***		*F* = 49.8***		*F* = 53.3***		*F* = 52.8***
N	18,456	18,456	15,233	15,233	20,479	20,479	20,080	20,080	20,080	20,080
Panel II: males										
Sports	0.158*** (0.027)	−1.30 (0.940)	0.156*** (0.025)	−1.11 (0.987)	0.078*** (0.011)	0.301 (0.476)	−0.040*** (0.013)	0.512 (0.454)	−0.048*** (0.011)	0.470 (0.314)
Wald 95% CI	[−3.14, 0.544]	[−3.04, 0.826]	[−0.631, 1.23]	[−0.377, 1.40]	[−0.146, 1.09]					
Conditional likelihood ratio 95% CI	[−5.65, 0.359]	[−13.6, 0.894]	[−0.743, 1.91]	[−0.323, 2.32]	[−0.190, 2.09]					
p-Value on height in OLS regression	*p* = 0.11		*p* = 0.16		*p* = 0.48		*p* = 0.19		*p* = 0.12	
First-stage equation results										
Height (in.)		0.004*** (0.001)		0.003** (0.001)		0.003** (0.001)		0.004*** (0.001)		0.004*** (0.001)
F-Test of instrument		*F* = 10.6***		*F* = 7.2**		*F* = 9.5***		*F* = 10.7***		*F* = 10.7***
N	9164	9164	7582	7582	10,146	10,146	9960	9960	9961	9961
Panel III: females										
Sports	0.118*** (0.022)	−0.372 (0.577)	0.114*** (0.018)	−0.117 (0.441)	0.038*** (0.009)	0.128 (0.271)	0.003 (0.009)	0.464* (0.257)	−0.018** (0.008)	−0.075 (0.173)
Wald 95% CI	[−1.50, 0.760]	[−0.928, 0.748]	[−0.403, 0.658]	[−0.040, 0.967]	[−0.415, 0.264]					
Conditional likelihood ratio 95% CI	[−2.53, 0.971]	[−1.28, 0.826]	[−0.458, 0.808]	[−0.056, 1.44]	[−0.562, 0.355]					
p-Value on height in OLS regression	*p* = 0.38		*p* = 0.55		*p* = 0.74		*p* = 0.05		*p* = 0.74	
First-stage equation results										
Height (in.)		0.005*** (0.002)		0.007*** (0.002)		0.006*** (0.002)		0.006*** (0.002)		0.006*** (0.002)
F-Test of instrument		*F* = 9.4***		*F* = 11.9***		*F* = 13.9***		*F* = 13.8***		*F* = 13.8***
N	9292	9292	7651	7651	10,333	10,333	10,120	10,120	10,119	10,119

Notes: OLS and 2SLS estimates are from unweighted regressions based on Wave I of the National Longitudinal Study of Adolescent Health. Standard errors corrected for clustering at the school level are in parentheses.

[a] All models include controls for demographic characteristics, school characteristics, parental school involvement, physical and mental health, PPVT score, and puberty controls.

[*] Statistically significant at the 10% level.

[**] Statistically significant at the 5% level.

[***] Statistically significant at the 1% level.

5. Conclusions

While many previous studies have shown that high school athletes receive better grades (Darling et al., 2005; Eccles & Barber, 1999; Eitle & Eitle, 2002; Silliker & Quirk, 1997), have higher educational and occupational aspirations (Darling et al., 2005; Marsh & Kleitman, 2002; Otto & Alwin, 1977; Sabo et al., 1993), spend more time doing homework (Marsh & Kleitman, 2002), and have a more positive attitude towards school (Darling et al., 2005; Eccles & Barber, 1999) than non-athletes, it is not clear if these correlations reflect causal relationships or are driven, in whole or in part, by unmeasured heterogeneity. Our study contributes to this body of literature by attempting to distinguish between these hypotheses.

While OLS estimates consistently show that those who participate in athletic activities have higher grades, greater college aspirations, and less difficulty completing homework or paying attention in class, fixed effects and instrumental variables estimates are much smaller in magnitude or are of the opposite sign. These findings suggest that previous reports of substantial positive academic spillovers associated with sports participation are overstated due to unmeasured heterogeneity and suggest that programs and policies designed to encourage sports participation are unlikely to produce important contemporaneous positive effects on student grades.

The only outcome for which there is some evidence of positive human capital spillovers of sports involvement is aspirations to attend college, consistent with previous findings on future expectations (Darling et al., 2005; Marsh & Kleitman, 2002; Otto & Alwin, 1977; Sabo et al., 1993). This result is also consistent with those of studies that examined the relationship between sports participation and years of education attained (Barron et al., 2000; Eide & Ronan, 2001).

Although we find little evidence to support the claim that sports participation is positively related to academic performance in a causal sense, our results do not rule out other human capital related benefits of sports participation, such as the accumulation of social capital (Persico et al., 2004). For instance, it may be the case that sports participation increases years of education attained and future earnings through the enhancement of social adaptability and the development of athletic skills, or the revelation of those skills to college admissions officers.

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