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Empirical Evidence on Educational Effects of Physical Activity: Four Examples¹²

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¹ This paper is based on my keynote address at the annual meeting of the Arbeitskreis Sportökonomie e.V. 2016 in Tübingen. I would like to thank the organizers for their excellent support as well as the participants for helpful and interesting discussions.

² The reason why I am using my own work to illustrate these issues is simply that I know these papers best. I am very much indebted to my co-authors, namely Charlotte Cabane, Christina Felfe, Hans Fricke, Adrian Hille, Michael Knaus, Anne Reimers, and Andreas Steinmayr, for their important contributions to these papers. Without them, the papers would not have been possible.

Abstract

In this paper, we address the question of how physical activity of children and young adults affect their educational outcomes. To do so, we will take up four examples of our own work to illustrate different aspects of this research agenda. In contrast to the amazingly large literature on health effects, educational outcomes received much less attention. This is surprising given that building-up human capital is an undisputable and very expensive goal of (almost) all countries. Exploiting the 'side-effects' of sports and physical activity in this direction may be a cost-efficient way of improving the human capital of young people and thus increasing the future productivity of the economy.

Three of the examples are based on German data, while one is based on Swiss data. Essentially, the three papers investigating the question of more versus less sports find that more sports is beneficial for cognitive skills (and some non-cognitive skills as well). Concerning the paper that compares sports activities to music related activities, the advantages of sports (compared to spending the time in structural music activity) on educational outcomes however cannot be established.

Keywords

Sports economics, human capital, education.

JEL Classification:

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1 Introduction

In this chapter, we address the question of how physical activity of children and young adults affect their educational outcomes. To do so, we will take up four examples of our own work to illustrate different aspects of this research agenda.² In contrast to the amazingly large literature on health effects (e.g. Strong et al., 2005), educational outcomes received much less attention (see however Barron, Ewing, & Waddell, 2000; Eide & Ronan, 2001; Pfeifer & Cornelissen, 2010; Stevenson, 2010). This is a bit surprising given that building-up human capital is an undisputable and very expensive goal of (almost) all countries. Exploiting the ‘side-effects’ of sports and physical activity in this direction may be a cost-efficient way of improving the human capital of young people and thus increasing the future productivity of the economy.

However, obtaining credible empirical information in this field of study may not be easy. All studies investigating the educational effects of various types of sports and physical activity have to rely in some sense on relating the observed variation in activity levels to the educational outcomes of these children and young adults. Unfortunately, it may be well true that those individuals who are observed as very active and performing very well in education share some characteristics, e.g. parental background, that makes them more successful at school anyway, for any activity level. The crux for any empirical study is thus the non-random choice of activity levels. Statistically speaking, there may be confounding variables, observable or unobservable that contaminate the empirical link between activity level and educational outcomes. Therefore, particular care needs to be taken with respect to an appropriate

empirical design that allows drawing ‘causal inference’ from the available data. However, even once such a design has been found and implemented, there is still the issue of avoiding biases coming from ‘inappropriate’ estimation methods. Usually, such biases come from estimators that are not well suited for the empirical set-up used and not being flexible enough. Concerning the latter, it appears to be important, as emphasized by a large literature in microeconometrics over the last 30 years or so, to allow for individual effect heterogeneity as well as flexibly controlling for observable control variables (see the excellent methodological discussions of identification and flexible estimation, for example, in Imbens and Wooldridge, 2009, and Angrist and Pischke, 2010).

In the remainder of this short note, we discuss four empirical examples. Three of them are based on German data, while one is based on Swiss data. Essentially, the papers investigating the question of more versus less sports find that more sports is beneficial for cognitive skills (and some non-cognitive skills as well). Concerning the comparison of sports vs. music, the advantages of sports (compared to spending the time in structural music activity) on educational outcomes however cannot be established.

In Section 2, we start with the effects of participating in club sports for younger children on cognitive and non-cognitive skills in the next section. In this paper, the research design has to address the issue of the non-random decision of children to be more or less active. This is done by exploiting the particular structure of several panel and cross-sectional data sets using a suitable (modified) matching strategy. Section 3 focuses on schoolchildren and the effects of the number of hours of school sports on their cognitive and non-cognitive skills, as well as on their motoric abilities. Here, the concern is that children who face fewer sports lessons (for example because no sports teacher is available) also face (usually) worse conditions in other parts of their school. Therefore, we exploit (arguably exogenous) variation of compulsory sports lessons across German states and use this to build an instrumental variable strategy that should take care of these concerns. In Section 4, we address the question that children face time (and other) constraints concerning the allocation of their leisure time. The idea is that if they become more active in the beneficial activity of sports, something else has to be substituted for the additional time needed. The effect of sports may indeed very much depend on which activity is substituted for sports. Since an obvious alternative potentially beneficial activity is taking music

lessons and playing instruments (e.g. Hille & Schupp, 2015), we compare these activities against each other. Here again, a suitably modified matching approach is used. In Section 5, we investigate the effect of participating in on-campus sports of university students. Since the available data that would be useful for successfully addressing the issue of non-random selection of individual activity levels is too limited, we conduct an incentive-based experimental study at a Swiss University. Finally, we draw some conclusion and identify shortcomings and future areas for research in Section 6.

2 Club sports activity of young children

2.1 The research question

In Felfe, Lechner and Steinmayr (2016; FLM henceforth) we are interested in analyzing the effects of extracurricular sports participation (in clubs) on younger children. This subpopulation seems to be of major relevance as there is a large literature showing that ‘early interventions’ appear to be particularly useful tools to improve children’s future life in many dimensions (e.g. Cunha, Heckman, Lochner, & Masterov, 2006).

2.2 The empirical design

The empirical analysis is based on two German data sets that have different strengths and weaknesses. The first data used is the *German Health Interview and Examination Survey for Children and Adolescents* (KiGGS) with about 6,000 children of 3 to 10 years of age. This cross-sectional data (later on it became a panel) is very informative in terms of cognitive and non-cognitive skills, health, child and household characteristics among other things. The second data used is the so-called *Kinderpanel* (i.e. child panel) which is a smaller and less informative data set. It is however a panel with three waves (at the time of the study). Due to the informative data, two different matching approaches could be implemented. Since it appeared plausible that the KiGGS data contained all confounding variables, FLM used standard matching methods with it. As a robustness check, a strategy using the distance to the next sports facility was implemented as well. For the child panel, we exploited the panel

structure to control for some time constant unobservables by implementing a matching approach as suggested by Lechner (2009). Generally, the results from the different approaches were in line with each other, although the IV-strategy turned out to be too noisy leading to imprecise results.

2.3 Results and discussion

The findings of FLM were clear-cut: Increasing sports activities in clubs leads to improved health and well-being as well as to improvements in cognitive and non-cognitive skills. There appeared to be also two interesting heterogeneities: *First*, the results were larger for girls than for boys. This finding, however, lacks a clear-cut theoretical explanation. *Second*, the effects were also larger for children living in cities compared to children living in the countryside. Here, the obvious explanation is that the latter have a higher level of physical activity anyway.

3 School sport activity for children and adolescents

3.1 The research question

While sports in clubs are an important dimension of structured physical activity, the continuous sports experience of children takes place in school. This dimension is analyzed in Knaus, Lechner, and Reimers (2016, KLR henceforth).

3.2 The empirical design

The empirical challenge of such an analysis is that there are many reasons why the number of hours of actual sports lessons a particular child participates in vary. Some of them are institutional. In Germany, which is the concern of this study, the different regional authorities, i.e. 'Länder' (federal states), have different rules that regulate whether and when to have two or three compulsory sports lessons per week (sometimes depending on grade). While in principle the school may have only a very limited flexibility in implementing these rules, there are many resource related reasons why a particular school may deviate from these predefined levels. The most common one is probably that the school does not devote sufficient resources to ensure the appropriate level of sports lessons. An example is the case of a sports teacher being

ill and the school not substituting her by a teacher teaching sports lessons as well. Since it is unlikely that children are randomly allocated across schools with different levels of sports lessons³, there is a need for dealing with this non-random selection. In KLR, this is tackled by using the fact that the German federal states have different rules concerning the number of weekly sports lessons required in schools. Such an exogenous variation in required sports lessons can be employed to build up an instrumental variable, which can be used in a flexible, matching-based, instrumental variable approach.⁴ In KLR, this approach is combined with the so-called *Motorik Modul* (MoMo) of the KiGGS data, which adds further variables related in particular to the motoric dimension and the types and intensities of activities to the informative KiGGS data that have already been briefly described in the previous section.

3.3 Results and discussion

The findings of KLR strongly suggest that increasing the number of sports hours at school by one additional hour will improve cognitive skills as measured by the grades in math and German. However, the results also suggest that for boys there is a price to pay for this improvement in terms of an increase in conduct and peer problems. For girls on the other hand, peer relations in fact improved. It remains a matter of future research to investigate the reason for these gender differences.

4 A comparison with other activities: Sports vs. Music

4.1 The research question

The study by Cabane, Hille and Lechner (2016, CHL henceforth) is motivated by the fact that there is a literature suggesting that sports is not the only extracurricular activity that may lead to positive effects on cognitive (and non-cognitive) skills. For example, Hille and Schupp (2015) find, that musical activity has positive effects as well. However, since time budgets of children and their parents are limited, there is a trade-off concerning spending time in different activities. CHL analyze this trade-

³ It is more likely that children from poorer families end up in schools that have fewer resources and are thus likely to have fewer sports lessons.

⁴ Cawley, Frisvold and Meyerhoefer (2013) and Cawley, Meyerhoefer and Newhouse (2007) exploit a similar variation for the US, although based on much less informative data and less sophisticated statistical tools.

off and try to analyze the effects of sports versus musical activities for a population that decided to participate in at least one of those two different activities.

4.2 The empirical design

Two features complicate this empirical study. *First*, it is very rare to find data sources that are informative about both sports *and* musical activities of children and also contain all the necessary background variables necessary for such a comparison. The German Socio-Economic Panel (SOEP) is indeed such a database. Its longitudinal character as well as its focus on all members of a household allows to link parents and their children and to measure activities for the children reasonably well. *Second*, participation in those activities is not random. CHL argue, however, that by considering only children that do at least one of the two activities the most difficult selection step, namely the decision to be active at all, does not need to be modelled. Furthermore, CHL argue that the SOEP is informative enough to control for the confounders of the music vs. sports activity decision. These arguments are underpinned by the fact that, for example, parents' characteristics of active and non-active children differ substantially, while those for doing sports and those doing music are very similar. Therefore, a matching strategy is applied to analyze this comparison.

4.3 Results and discussion

The results of CHL indicate that music and sports activities indeed have different effects. While sports activities improve health, playing music improves academic performance. This is in particular the case for girls in families with parents of high education. Interestingly, this also goes along with additional time spent reading and less time spent watching TV or playing computer games. Therefore, the conclusion for parents is not straightforward leading to a health vs. better academic performance trade-off. As both, health and educational human capital, will lead to better labour market performance later on, the trade-off is probably not so crucial in the long-run. However, this remains subject to future research.

5 University sports activity for students

5.1 The research question

Having investigated kindergarten- and schoolchildren, the question appears whether there are also effects on educational outcome gains for more active students, who usually enjoy a rich supply of low-cost possibilities of sport activities as provided (or at least subsidized) by universities. In the US, one may argue that such investments are justified even if they increase the leisure value of academic studies only, because studies are largely funded by the students themselves. However, the situation is different in many European countries where taxpayers largely pay for the universities, including much of their expenditures on sports facilities, as well as on running large instructed sports programs. Thus, Fricke, Lechner and Steinmayr (2016, FrLS henceforth) investigate whether participating in university sports is beneficial for the academic achievements of students.

5.2 The empirical design

Like in other settings, the non-randomness of the decision to participate in university sports is an issue to be dealt with. Similar to the case of children's extracurricular sports activities (see FLS), descriptive evidence suggests that students who are likely to do better in academic studies are also more likely to be more frequent participants in campus sports. However, we are not aware of any data set measuring students' sports participation on campus and their academic outcomes that is at the same time also rich enough to control for the occurring confounding. If this is the case and if no other exogenous variation is available, then the (high-cost) alternative of running an experimental study may be the only option. However, in the case of sports, it will be difficult to randomize participation directly (at least in a manner considered to be ethical).

Therefore, FrLS conducted a randomized study at a Swiss university. The randomization related to a monetary reward (framed as a 'loss' to increase its bite) which was maximized by participating in university sports at least twice per week (during term time). In such a case, the randomized-in group would get a monetary reward of

CHF 100 (about EUR 90), while the control group would not get anything. The population of this experiment consisted of the two cohorts entering the first term of the university in 2013 and 2014. They were eligible to the bonus payment for their first two terms only. In econometric terms, randomization in such a setting provides an instrument.⁵ FrLS combine this experimental setting with data from university records containing information on grades and a few socio-economic background variables of the students. Detailed activity data are obtained from scanners located at the entrance of the university sports facilities. Finally, several online surveys were conducted (with varying response rates) to collect more information on students' backgrounds as well as on their off-campus activities.

5.3 Results and discussion

The results show that cash incentives indeed raised the participation in sport activities on campus substantially. It appears that at least for the first cohort, one additional visit per week (which corresponds on average to an activity increase of more than 100%) improves the grades by about 0.6 standard deviations. Men mainly drive this effect. The data suggests that this impact does not come from students doing more sports. Instead, they substitute off-campus sports by on-campus sports. They also spent more time on campus in general, including time spent in lectures. This pattern suggests that the educational gains are not coming from improved health, as activity levels remained more or less constant, but from spending more time on campus. A different, but related driver may come from a changed peer composition, as students meet different peers on campus as compared to off-campus. However, for a yet unknown reason, the second cohort reacted much less to the incentives, so that FrLS could not confirm these results for them.

6 Conclusions and some open issues

The studies briefly described above show credible evidence for positive effects of additional sports activities on academic achievements. They covered different age ranges of young people and considered a variety of different physical activities. In

⁵ The instrument can be used, for example, in a two stage least squares approach to estimate the effects of sports activity on outcomes of interest.

that sense, although every single study has its shortcomings, in total, the evidence appears to be overwhelming and in line with the (limited) literature on this topic.

Despite these clear-cut conclusions, many issues are still open. *First*, a largely neglected issue is cost effectiveness. The studies mentioned above are all silent on costs and monetary benefits, essentially because of a lack of cost information. *Second*, there is also no information on how such short-term effects translate into long-term gains in later life. *Third*, another issue relates to questions about the optimal ‘dose’ of sports, as, clearly, playing football all day cannot maximize educational outcomes. *Fourth*, it may be conjectured that different types of activities are differently effective for different types of cognitive and non-cognitive skills (like individual vs. team sports).

In this regard, the appearance of Big Data (like the information gathered by activity trackers) provides great possibilities (provided some additional challenges can be overcome) for many exiting and credible new empirical studies addressing such unresolved issues in this important field of research.

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