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Physical exercise and social inequality in Norway – A comparison of OLS and quantile regression analysis

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Abstract: About two thirds of the Norwegian population exercise less than recommended by public authorities. Traditional studies of exercise and social inequality using OLS-regression give us information on the average person (conditioned mean value of a distribution), but might ignore information useful for understanding the situation for those, as in the Norwegian case, less physically active. In this article quantile regression – addressing units at various quantiles, not only the mean – is used to study social inequality related to physical exercise. Three types of exercise are studied – exercising locally, associational sport, fitness exercise – in light of social background variables. The crux of the analyses is an understanding of how the dependence of various independent variables differs across quantiles and that these results in several cases also differ from what OLS-regression tells us. The data applied are Norwegian (ISSP 2007).

Keywords: physical activity, exercise, sport, social inequality, quantile regression

Introduction

Sufficient physical activity and exercise are largely seen as prerequisites for health and welfare in modern societies (Warburton, Nicol, & Bredin, 2006). Accordingly, many nations have introduced and adopted policies aimed at promoting and facilitating people's physical activity (Bergsgard, Mangset, Houlihan, Nødland, & Rommetvedt, 2007; Houlihan & Lindsey, 2013; Stewart, Nicholson, Smith, & Westerbeek, 2004). A requirement for developing such policies is knowledge of which groups in the population are at risk of not being physically active. However, providing the most relevant information is challenging because research findings on physical activity – essentially discovering who is fit and who is not – depends on the methods applied, the criteria used to distinguish fit from unfit, the types of action studied and the social characteristics in focus.

In this article, I embark on a study of the relationship between physical activity and social inequality. The problem with many studies of physical activity is that the most commonly used statistics, for example ordinary least squares (OLS) regression, are not necessarily the best method for identifying those at risk. These traditional statistics provide information on the average person in a sample, but in most cases regarding sport, exercise and physical activity, the persons of interest are not at the centre of a distribution and instead are generally found toward the margins. One such example is the Norwegian authorities' claim that approximately two-thirds of the

adult population move or exercise less than recommended (Helsedirektoratet, 2014). Thus, for a social science to provide useful knowledge for health policies it should focus on these marginal groups, rather than the ‘typical’ or average person.

Quantile regression (QR) represents one way to achieve this aim. Until now, this method has had little impact in the social sciences (Goertz, Hak, & Dul, 2012), yet in this study, I will consider how, and the extent to which, people are physically active from the point of view of QR. What is noteworthy about this method is its focus on how the values at different quantiles of a set of (dependent) variables – *f* ex various forms of physical activity – depend on the value of a set of independent variables. This means the method provides information on the characteristics important for different groups of people dependent on their, in this case, level of physical activity, and not only those at the centre of a distribution. As a result, this method could, for example, provide more explicit information on those not yet fit (*f* ex at 1/3 quantiles), rather than information on an average person.

From this, the purpose of the article is twofold. First, the aim is to enhance the understanding of physical activity and social inequality in a modern Western nation, with a particular focus on the least active members of the population. Second, with an eye to methodological issues, the aim is to investigate whether and how it makes a difference to focus on various quantiles of a distribution rather than the average when studying social inequality and physical activity. To achieve these two aims, I will answer two sets of questions. Initially, and primarily as a background to the subsequent analyses, I will investigate in which settings and how often people exercise. Next, I will investigate how social background and available resources affect the level of exercise for various groups of people in these settings. The crux of the study is that obtaining full answers to these questions requires an understanding of how the effects of explanatory factors depend on which quantiles of the dependent variable are in focus.

The article is structured as follows. First, I will present a typology of physical exercise, review relevant findings from previous research related to social inequality and physical exercise and outline a set of hypotheses. Since QR is a method not well known in sociology, in the methodology section I will devote particular attention to presenting it. Subsequently, I will present the empirical results in three parts, before summing up and addressing some of the implications of the results of the study.

Background, review and theory

Physical exercise and sport as we find them in most Western nations today are modern inventions, yet are largely linked to three historical traditions: competitive sport (English tradition), gymnastics (German and Swedish traditions) and outdoor recreational life (Goksøyr, 2008; Guttmann, 2004; Mandell, 1984). Both previous and recent empirical research indicate that in present-day Norway there remain three dominant types of physical activity that partly reflect these historical traditions (Brei-

vik & Hellevik, 2013; Vaage, 2009). First, we have physical activity as it is practiced outside formal organisations, either at home or in local settings (and either alone or in smaller groups), typically comprising jogging or exercising. Second, we find sport and physical activity within sports associations; this is the traditional way of participating in sports within a Norwegian setting, especially for children and youths. Third, and most recently, an increasing number of people are engaged in physical activity at fitness centres.

A considerable body of sociological literature deals with questions related to physical exercise and sport and their connection with social inequality, addressing explanatory factors such as gender, age, class, income, education, occupation and family situation.¹ The hypotheses outlined below are based on this voluminous literature, but with the caveat that hardly any of these contributions offer the full picture needed to substantiate hypotheses addressing the specific questions – effects at various quantiles for three different forms of physical action – relevant for this article. Accordingly, some of the hypotheses will be rather exploratory.

To explicate how the many explanatory factors involved at the three exercise settings matter, I adopt the general theoretical approach presented by Hedström (2005). From this perspective, a decision to engage in physical activity could result from two sets of factors. On the one hand, it is simply a result of the opportunities available to be physically active. These types of opportunities could, for example, reflect sufficient income to pay the membership fees to join a fitness centre, or not living too far away from it. On the other hand, some factors – such as desires and beliefs – are inherent to the individual (yet nevertheless reflect social factors): education might further knowledge of the importance of physical health, and being single might entail an incentive to look more attractive. Together, these factors – opportunities, beliefs and desires – function as useful heuristics when trying to understand why people exercise, specifically by making it possible to explicate how the variables included in this review might matter for physical activity.

One of the most obvious and significant factors in explaining engagement in physical activity is age. The assumption has traditionally been that physical activity decreases with age, mostly due to dwindling physical capabilities. Yet some of these taken-for-granted assumptions about how age matters are about to change (Hovemann & Wicker, 2009; Vaage, 2009). In terms of levels of activity, recent findings

1 See: Bairner, 2007; Beenackers et al., 2012; Bennett, 2009; Bergman, Grjibovski, Hagströmer, Bauman, & Sjöström, 2008; Bourdieu, 1978; Cachay & Hartmann-Tews, 1998; Crossley, 2006; Dahl & Birkelund, 1999; Danielsen, 1989; Donnelly, 1996; Dølvik, 1990; Dølvik, Danielsen, & Hernes, 1988; Elstad, 2000; Gruneau, 1999; Lüschen, 1984; Morgan, 1994; Scheerder, Vanreusel, & Taks, 2005; Scheerder, Vanreusel, Taks, & Renson, 2002; Stokvis, 2011; Studer, Schlesinger, & Engel, 2011; Sugden & Tomlinson, 2000; Thrane, 2001; Tomlinson, 2004; Vaage, 2009; Van Tuyckom, 2011; Van Tuyckom, Scheerder, & Bracke, 2010; Veenstra, 2007; Warde, 2006; Williams, 1995.

indicate that older people are increasingly participating in physical activity (partly due to better health, lower retirement age and better opportunities). Therefore, although I expect to find a negative correlation between physical activities and age for all settings and arenas included in this study, the effect of age is likely to be less pronounced than it was previously. When it comes to the setting or arena for carrying out physical activity, the most important finding appears to be the predominance of younger people using fitness centres (Ulseth, 2004). It is arguable that this is partly because older people are engaged in traditional forms of physical activities, which are not typically the kinds of activities arranged by fitness centres. The question of how the effect of age might differ at various quantiles remains open, but one possibility is that age makes the most difference among those who are the most active.

Physical exercise and sport have traditionally been heavily gendered activities, but the picture is most likely more complex today than it was in the past (Dunning, 1999; Fasting, 2008; Hargreaves, 1994; Hartmann-Tews & Pfister, 2003; Taniguchi & Shupe, 2014; Vaage, 2009; Van Tuyckom et al., 2010). In the Norwegian context today, women seem to be more physically active than men, but there are likely to be significant differences between settings; where sports associations continue to be male dominated (Enjolras & Wollebæk, 2010), modern fitness centres are dominated by women (Smith Maguire, 2007; Ulseth, 2004). In addition, with regard to the most common physical activity arena – exercise in one's local surroundings – research seems to indicate that women participate more than men (Vaage, 2009). There are several potential reasons for the increase in women's physical activity. First, there have been shifts in opportunities – including the development of activities that are more attractive to women – women's resources and family patterns. In addition, we have also witnessed changes in women's values and competencies, which have led them to become more interested in and capable of taking advantage of both old and new opportunities. It remains difficult to provide specific assumptions about gender effects at various levels of activity (quantiles).

Meanwhile, there have been several connections drawn between social class and physical activity. Bourdieu (1978, 1990) focused primarily on how sport is linked to processes of social stratification, and what kind of meaning different social strata attach to sports. In line with Bourdieu, a distinction is usually made between class (Marxist tradition) and status (Weberian tradition) (Chan & Goldthorpe, 2007). In this study, I will build on this tradition and, in a relatively straightforward manner, operationalise class as income and status as education.

Class as income could have two potential effects on the level and type of physical exercise (Scheerder, 2011; Scheerder et al., 2005; Stokvis, 2011; Studer et al., 2011). The first of these effects simply involves those with higher incomes having more material resources; since physical activity and sport often involve costs, a high income will generally increase the probability of being physically active. A second

relevant aspect of income assumes that high incomes reflect certain types of work that offer a higher degree of autonomy and flexibility in terms of time, and thereby make it easier to find time for physical exercise. Moreover, I hypothesise that membership of fitness centres is generally more expensive than for sports clubs; sport practiced in everyday life is usually the least expensive form of physical activity. This makes it reasonable to assume that to the extent income matters, it carries most importance for fitness, followed by associational sports and finally local exercising. In terms of income as a resource, I assume that it is more relevant for those who are less physically active, since a lack of material resources reflected in income functions as a hindrance for participating in physical activity.

Education entails at least three types of resources significant for physical activity. First, it has a cognitive component, as knowledge of the positive effects of physical activity should imply a higher level of that activity, regardless of setting. Second, education could also imply the same type of effect as high income in reflecting a more flexible everyday life that makes it easier to find time to exercise. Third, sport and physical activity often hold strong positions at educational institutions, which means education could have a socialising effect in preparing students for 'post-educational' physical exercise. There are different social mechanisms inherent in education, but they all point in the direction of a positive correlation between education and physical activity. Education is arguably preparing people for most types of physical activity, but, as with income, perhaps through an indirect effect (type of work). One could also believe that education has a stronger effect among those at the higher exercise levels.

A recent critique of class studies claimed that the concept is used in too abstract a manner, and that it would be more appropriate to focus on occupations or professions (Weeden & Grusky, 2005). It is not possible to respond fully to this argument here, but one obvious factor is one's employment status, and a general assumption (controlling for income [as type of work]) is that being employed makes it difficult to exercise due to a lack of time. A second factor I will consider alongside employment is whether one is a student or not, since students often have good opportunities for exercise, especially when it comes to the gym and fitness centres. Family situation might also relate to one's interest in and opportunities for being physically active or participating in sport; a simple means of examining this is by assuming that marital status makes a difference. On the one hand, one should assume that those who are single are more interested in staying fit than those who are married, and, as such, that marriage is a negative influence on physical activity in general. On the other hand, being married might make it easier to find time for exercise. The factors discussed towards the end of this section have an either-or logic, which makes it reasonable to believe that their effects are eventually to be found among those who are least active.

Methods and data

The data applied in this article stems from the Norwegian version of the international Social Survey Programme data on Sport and Leisure from 2007. This is a postal survey involving 1143 respondents, a response rate of 42 per cent, and a certain over-representation of older people and women in the survey.² For the current relevance of the data, the participation in the various activities are largely the same (Breivik, 2013), even though fitness and local activities have become more popular and sport associations (for adults) have decreased participation. Speculating on the implication of these shifts, one possibility is that larger and smaller participation respectively could imply smaller and larger social inequalities today than at the time of the data collection. However, the results from the Norwegian case should prove interesting to a more general audience for several reasons. First, several Western nations have similar sport infrastructures: a mixture of sports associations, an expanding fitness sector and many people exercising by themselves (Vaage, 2009). Second, some of the social trends, with more differentiated patterns of physical exercise, are also found elsewhere, and third, the explanatory factors are similar across nations. Thus, phenomena that may constitute the most pressing social problems in most Western nations do not relate to the average person, but rather to people at the margins.³

Accordingly, the purpose of this article is to contribute to an understanding of what makes a difference to the type and level of physical exercise carried out in a late modern society. First, I will study how social differences pertain to different types of physical activity. However, the second and more original question I examine involves the extent to which there are differences in how certain explanatory factors affect those who are not as physically active as recommended by public authorities.

For the first task (studying differences between various types of physical activity), the proper methods are simple frequency distributions, factor analyses and OLS regression analyses. However, OLS regression is not a suitable approach for the second question because of its narrow focus on the mean of the response variables, whereas our interest also includes the effects of explanatory factors for physical activity found elsewhere on the distribution, especially those close to the 25 per cent quantile.

There are several approaches available to meet such challenges (Andersen, 2008; Berk, 2004, 2008; Fox, 2008), yet one method particularly well-suited to our purposes is QR (Hao & Naiman, 2007; Koenker, 2005). An initial advantage is that, unlike OLS regression, this method is not oriented towards how independent varia-

2 See http://www.nsd.uib.no/rapport/nsd_rapport123.pdf for more information on the data. For data: <http://www.gesis.org/en/issp/issp-modules-profiles/leisure-time-sports/>

3 A recent and interesting example of the same point, the interest of social inequality not concerning the mean, is found in Tomas Piketty's book on Capital in the 21st century (Piketty & Goldhammer, 2014).

bles influence the mean of the dependent variable, but rather how they have an impact on one or more quantiles of the dependent variable. This makes it extremely suitable for answering the types of questions in focus here. Second, QR is a better method than OLS (and logistic regression) because its statistical requirements are less strict, especially when it comes to the assumption of residuals (particularly heteroskedasticity). It is also more robust regarding outliers and skewness (Hao & Naiman, 2007; Koenker, 2005).

We can understand QR as being parallel to OLS regression in that it results in a model where the value of a dependent variable is conditioned on the values of one or more independent variables. Again, the main difference is that OLS regression is based on the mean value of the dependent variable, whereas QR is based on one or more quantiles. The best-known quantile is the median, the value dividing a distribution into two equally large parts. However, any point in the distribution represents a quantile; for example, $Q=0.10$ will represent the value distinguishing the 10 per cent least physically active from the rest of the distribution. The most direct QR parallel to OLS is the median regression, where the results show how the median value depends on the values of our independent variables. This might be similar to the mean, but in several instances regarding social inequality (for skewed distributions or distributions with influential outliers) the mean and median differ significantly. For our purpose, it is most interesting to study the effect of explanatory variables on the lower quantiles. Thus, QR provides a method of examining what affects physical activity levels among those who are less physically active (as contrasted with those at a higher or average level). The interpretations of the results are again parallel to OLS regression. Regression coefficients (unstandardised) tell us the extent to which the value of the dependent variable (for a quantile) changes when shifting the value of independent variables with one unit (holding other values constant). Standard errors based on bootstrapping are generated to evaluate the probability of coefficients being different from zero.

I present the results in tables containing the regression coefficients for each quantile and OLS regression, and asterisks indicating the extent to which the variables have significant effects. However, there is more information presented here than in traditional OLS regression, which means I have chosen to present, for each type of activity, the effect of the most important variables as separate figures. These figures give the values for each QR coefficient for a selection of variables. The coefficients with significant values have filled points (•), the non-significant values have empty points (◦). I have given the results of the OLS regression as dotted horizontal lines, black when significant, grey when not significant. The QR coefficients are connected with a line, which makes it easy to compare the effect of each variable across quantiles, and to discern whether there are systematic patterns in the effects.

Choosing the type of model to build is a challenge in regression analysis (Young, 2009), and for quantile analysis the question is indeed pressing since one is actually working with several models at once. This poses a problem when deciding on which variables to include and how to expect them to affect dependent variables. This challenge becomes even more cumbersome when attempting to identify non-linear relationships and interaction effects, because these might differ in substance and statistical effect across quantiles in ways that make comparisons difficult. To keep the analyses relatively simple, I refrain from including non-linearity and interactions.

An important question relates to which, and how many, quantiles to include in the models. To both address our core concern (those at the lower quantiles) and to present a more complete picture of the distribution as such, I have chosen to include five quantiles: 0.10, 0.25, 0.50, 0.75 and 0.90. I will also present the results from OLS regression because they yield interesting findings and it will be worthwhile to compare the two forms of regression.

Table 1 presents the independent variables applied in the analyses. Gender, age, employment and student status should be self-explanatory, while education and personal income are recoded due to skewness and outliers. Education consists of years of education across five categories: 1) up to 9 years of education; 2) 10 to 12 years; 3) 13 to 15 years; 4) 16 and 17 years; and 5) more than 18 years. For income: 1) low through 150,000 NOK⁴; 2) 151,000 to 250,000 NOK; 3) 251,000 to 350,000 NOK; 4) 351,000 to 500,000 NOK; and 5) more than 500,000 NOK.

Table 1: Descriptive Statistics: Independent Variables

	Range	Mean	SD	N
Female	0 : 1	0.54	0.50	1143
Age	19 :80	46.9	15.3	1143
Education	1 : 5	2.9	1.2	1127
Income	1 : 5	2.89	1.44	1018
Married	0 : 1	0.54	0.50	1126
Employed	0 : 1	0.67	0.47	1134
Student	0 : 1	0.07	0.25	1134

I created all analyses and illustrations using R (R Development Core Team, 2014), where the *quantreg* package has been particularly important (Koenker, 2005).

Results

In this section, I will first present a comprehensive picture of how people exercise, and thereafter demonstrate how the three dimensions of physical exercise and sport

⁴ 1 US dollar = 6.5 NOK; 1 Euro = 8.2 NOK (at October 2014)

discussed above also appear in our data. Second, I present the main analyses of how the levels of three types of physical exercise and sport differ between various social groups, and in particular which factors most affect those who are less (at the lower quantiles) active.

Types and levels of physical exercise

The survey used in this research asked the respondents how often they were active within a chosen set of physical activity settings or arenas. Table 2 presents the results and clearly illustrates the differences between the prevalence of the various physical activities. The most apparent finding is that the majority of the population is active in the less-organised forms of exercise (at home, in their local environment) and the three main forms of recreational activities (cycling, skiing and hiking), whereas the more institutionalised forms of sport and physical exercise (sports associations, fitness centres, gyms at work or school, dancing) are less prevalent. This is consistent with previous research (Vaage, 2009).

Table 2: Descriptive Statistics: Dependent Variables. *How often do you exercise as listed below?*

	Never	Seldom	Once a week	2-3 times a week	4-7 times a week
In sport club	78.5	13.0	4.7	2.8	0.9
At fitness centre	61.0	16.0	6.8	13.2	3.0
At work or school	75.1	13.6	4.3	3.0	4.0
At home	28.0	38.9	9.0	14.5	9.7
In local environment	26.1	31.0	12.7	18.1	12.1
In swimming pool	54.9	38.6	4.7	1.3	0.6
Cycling	25.6	46.7	9.3	12.2	6.2
Dancing	45.6	49.2	3.1	1.5	0.6
Skiing	32.5	55.3	5.9	5.3	1.0
Hiking	5.7	36.4	16.0	20.4	21.4

To determine whether it is possible to reduce the number of physical activity dimensions – in order to retain some of the complexity of the phenomena while making it easier and more convenient to study social inequality – and to ascertain whether our data reflected the three-dimensional solution suggested above, I conducted a factor analysis (Table 3). As expected, the three-dimensional approach emerges, despite resulting in categories of action that are broader and a little more inclusive than the chosen terminology suggests.

Table 3: Factor analysis of Exercising Activities (see table 1). Varimax Rotation. KMO=0.70, Bartlett's test: Chi-Square=1011.8; df=45, sig=0.000.

	Factor 1: Exercising Locally	Factor 2: Sport and Recreation	Factor 3: Fitness
At home	0.693	0.000	0.224
In local environment	0.684	0.358	0.011
Hiking	0.725	0.090	0.017
In sport club	-0.296	0.547	0.337
Cycling	0.301	0.598	0.040
Skiing	0.163	0.746	0.003
At fitness centre	-0.196	0.163	0.523
At work or school	0.165	-0.152	0.704
In swimming pool	0.082	0.399	0.505
Dancing	0.267	0.002	0.568
<i>% of total variance</i>	<i>18.2</i>	<i>15.6</i>	<i>15.1</i>
<i># of test measures</i>	<i>3</i>	<i>3</i>	<i>4</i>

The first set of activities (factor: exercising locally) corresponds to the most common form of physical activity found in previous studies: everyday exercise at home, in the local community or hiking. In the second set of activities, we find that what I refer to as organised sport includes both activities organised by sports associations and more recreational activities, such as cycling and skiing. The third dimension incorporates the fitness sector as expected, but also includes those who exercise at work or school, and those who swim and dance.

Exercising locally

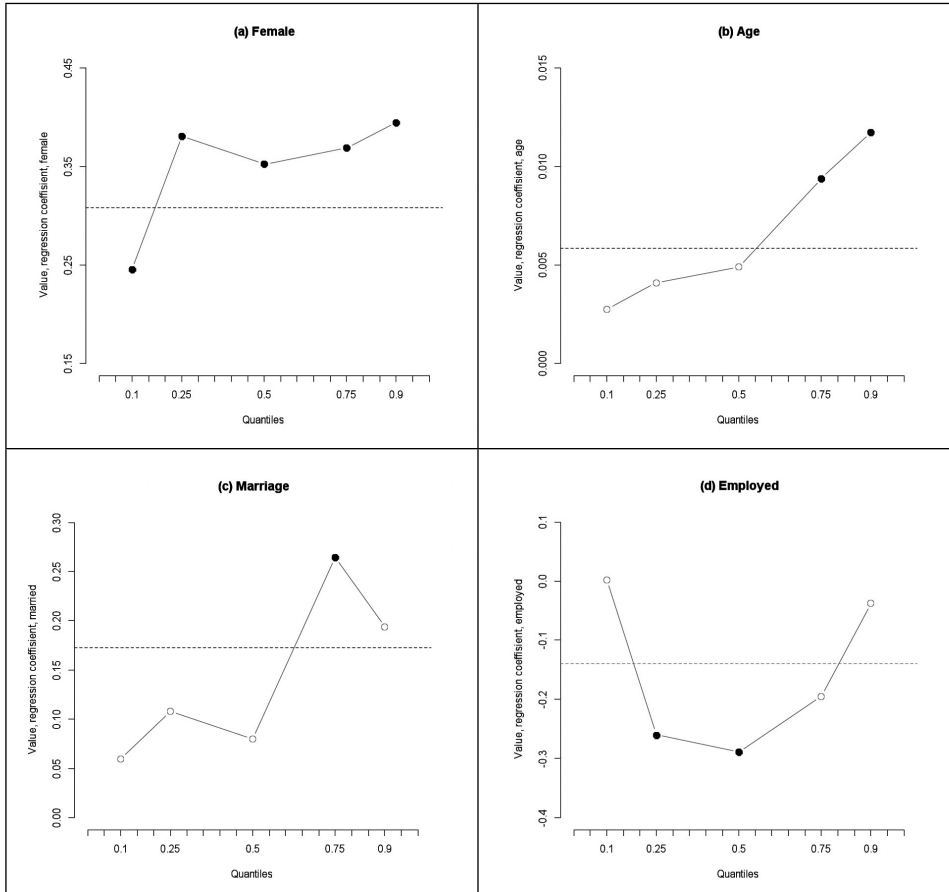
As shown, exercising locally is the most popular type of exercise. Given that this exercise type requires the least resources, it is hypothesised that it will not be affected extensively by variables reflecting material and cultural resources.

Table 4: Quantile and OLS-regression. Exercising locally. Regression Coefficients.

* p<0.10, ** p<0.05, *** p<0.01

	0.10	0.25	0.5	OLS	0.75	0.90
Intercept	-1.86***	-1.71***	-0.86***	-0.82***	-0.39	0.20
Female	0.25***	0.38***	0.35***	0.32***	0.37***	0.39***
Age	0.00	0.00	0.00	0.01**	0.01***	0.01**
Education	0.02	0.04	0.02	0.01	-0.02	-0.03
Income	0.02	0.09*	0.04	0.02	0.02	-0.03
Married	0.08	0.11	0.08	0.17*	0.26***	0.20
Employed	0.00	-0.26**	-0.29**	-0.15	-0.19	-0.04
Student	-0.36*	-0.08	-0.30*	-0.20	-0.13	-0.01

R²=0.05



Figures 1 a-d: Effects of (a) gender, (b) age, (c) marriage and (d) employment for Exercising Locally. Quantile and OLS regressions coefficients. Quantile regression: Points and whole line; significant effects: filled points, not significant effects: open points. OLS regression: dotted line, black when significant effect, otherwise grey.

The first point of interest in Table 4 is that exercising locally is, as expected, a form of exercise where material resources (income) and cultural resources (education) seem marginal. It is also the type of activity explained least by our variables (R^2 , OLS regression). In interpreting the OLS regression, we see that women are more active than men, and we find a weak but significant effect of age; the older the respondent is, the more s/he exercises. We also see that marital status matters, with those who are married being more active. In comparing the OLS regression with the QR, one pattern stands out, namely that gender matters at all levels of exercise. Women exercise more locally than men at all levels of exercise, but the effect of gender is lowest on the lower levels of exercise (Figure 1a). However, the significant effects of age can

only be found among those exercising at a higher-than-average level (Figure 1b). Marriage has much the same pattern; looking at the quantiles, it matters only for those engaging in a high level of exercise, and the effects are greater than for OLS regression (Figure 1c). Employment was not significant in OLS regression, but had a negative effect for those at median-to-low ($q=0.5$ and 0.25) levels of activity (Figure 1d).

In general, the QR offers more profound insights into how social inequalities operate, partly in showing how some effects that do not emerge as significant in OLS regression come to prominence when considering quantiles; this is particularly true of employment and student status. Moreover, we see more clearly how some of the independent variables seem to be more important at certain levels of activity than at others; for example, marriage matters for those who are most active, while employment affects those on a lower level of the scale. This means that the QR provides a richer understanding of the effects of the independent variables at different levels of activity.

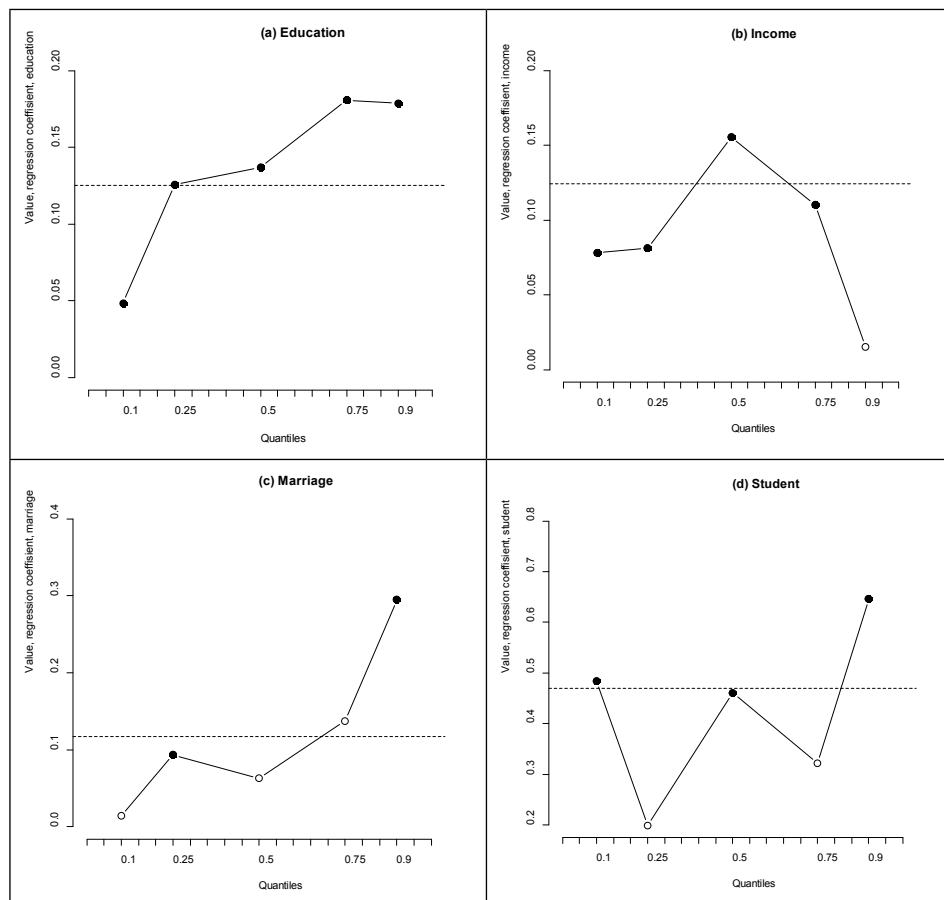
In looking at the practical implications for those who are not yet fit, it appears gender patterns are more or less as expected, but that age makes little difference at the low levels of activity. Moreover, employment matters at the 25 per cent quantile, which indicates that differences in material resources are important, despite income and education appearing less consequential. These are insignificant effects in the OLS regression, implying that the impression gained from it is somewhat misleading for those who are not yet fit.

Sports associations and recreational life

The assumptions are different when it comes to exercising in sports associations because doing so is often more expensive than exercise through everyday training due to the equipment required and participation fees.

Table 5: Quantile and OLS-regression. Exercising in Sports Associations. Regression Coefficients. * $p<0.10$, ** $p<0.05$, *** $p<0.01$

	0.10	0.25	0.5	OLS	0.75	0.90
Intercept	-1.55***	-1.12***	-1.08***	-0.44*	0.18	0.79
Female	0.02	-0.04	-0.03	-0.07	-0.07	-0.10
Age	-0.00	-0.00	-0.00	-0.01*	-0.01*	-0.00
Education	0.05*	0.13***	0.14***	0.13***	0.18***	0.18***
Income	0.08**	0.08**	0.15***	0.10**	0.11***	0.02
Married	0.02	0.09*	0.06	0.12*	0.14	0.31**
Employed	0.05	-0.02	0.20*	0.04	-0.04	0.09
Student	0.46***	0.20	0.46***	0.39**	0.30	0.65*
R ² =0.07						



Figures 2 a-d: Effects of (a) education, (b) income, (c) marriage and (d) being a student for Exercising in Sports Associations. Quantile and OLS regressions coefficients. Quantile regression: Points and whole line; significant effects: filled points, not significant effects: open points. OLS regression: dotted line, black when significant effect, otherwise grey.

Compared to exercising locally (OLS regression), material resources (income and education) matter, and a larger proportion of the variance is explained when it comes to associational sports. Comparing OLS regression to median regression does not reveal substantive differences in what appear to be the most important variables for those at the centre of the distribution: education, income and student status. However, when it comes to being married and employed, there are interesting differences.

An examination of education and income at the chosen quantiles show them all, with one exception, to be significant. Yet the two are different in the sense that the effect of education is greater (double) in the higher quantiles than the lower ones, whereas the effect of income appears less systematic across quantiles (Figure 2a and 2b). In considering the effect of being a student (Figure 2d), one sees that the signifi-

cant points are within a relatively restricted area; they are lower for the lower quantiles, but the pattern indicates that the significant effects are rather close to the OLS regression (Figure 2d). Being married seems to be most important for those on a high level of activity, with more significant effects for the higher quantiles ($q=0.90$) than for the lower quantiles ($q=0.25$).

The quantile technique offers a significantly different picture of the effect of education (compared to OLS), where the effect is significant across the spectrum of quantiles, but with one interesting difference (which was less clear in the analyses of local exercise). This is that the effect of education is much stronger for those who exercise often than for those who are less active.

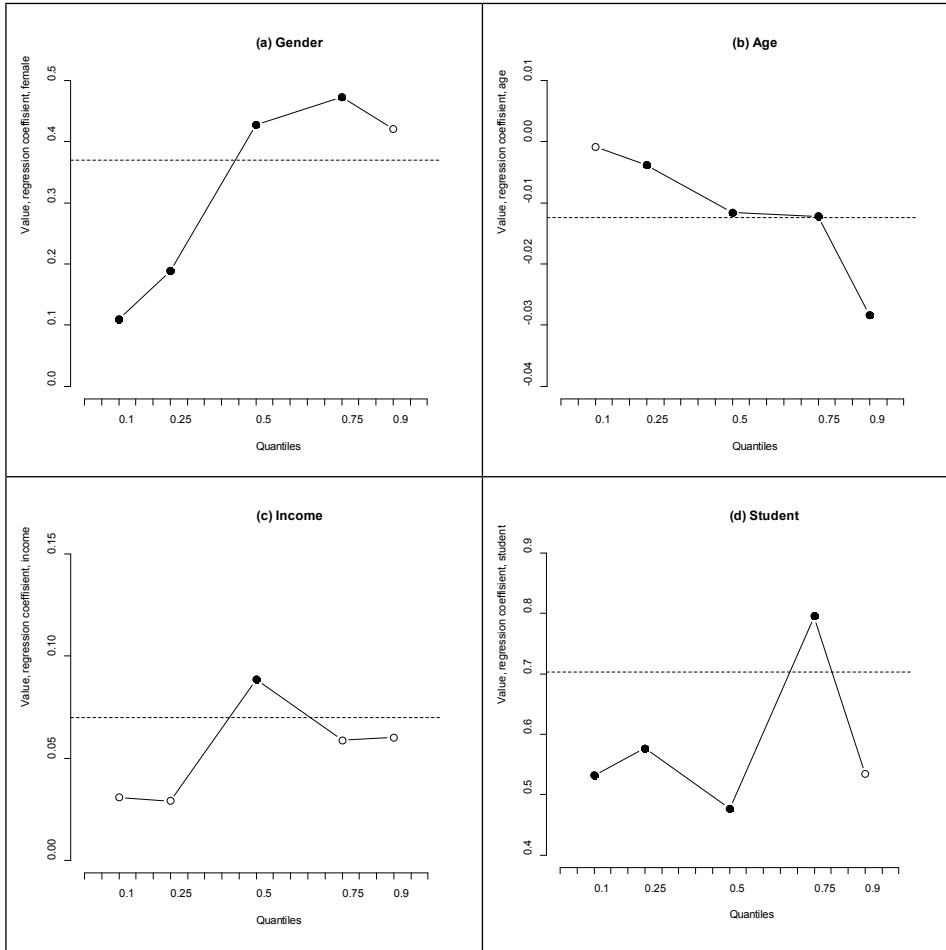
For those at a lower level of activity ($q=0.25$), it appears the traditional social inequality variables reflecting resources – income and education – are important, even though, as already mentioned, the effect of both education and income varies across quantiles. For those who are not yet fit, education and income matter, but less so than for those who are more active. In the case of associational sports, OLS regression provides a more appropriate indication of practice than it does for the other forms of exercise.

Fitness, gym and work

The most distinguishable activity group, hypothetically speaking, when it comes to resources (requirements of time and money) is exercising at fitness centres. This is also a group where we could expect to find differences related to social background, such as gender and age. Consistent with the abovementioned expectations, fitness exercise is, according to OLS regression, the form of activity with the highest percentage of explained variance. However, contrary to the assumptions, resources (income and education) are not overly important for fitness activities; what seems to matter is age, gender and student status. The fact that material resources have little effect is probably because the category called fitness includes a wider spectrum of activities than those generally associated with commercial fitness.

Table 6: Quantile and OLS-regression. Fitness Exercise. Regression Coefficients.
 * $p<0.10$, ** $p<0.05$, *** $p<0.01$

	0.10	0.25	0.5	OLS	0.75	0.90
Intercept	-1.14***	-0.87***	-0.49*	-0.18	0.19	2.00***
Female	0.11*	0.19***	0.43***	0.37***	0.47***	0.42
Age	-0.00	-0.00*	-0.01***	-0.01***	-0.01**	-0.03***
Education	-0.00	-0.01	-0.03	-0.02	-0.05	-0.20
Income	0.03	0.03	0.09**	0.06*	0.06	0.06
Married	-0.05	-0.01	-0.02	-0.03	-0.09	0.13
Employed	-0.05	0.01	-0.04	0.02	0.10	-0.10
Student	0.53***	0.58***	0.48**	0.70***	0.80***	0.53
				R2=0.12		



Figures 3 a-c: Effects of (a) gender, (b) age, (c) income and (d) being a student for Fitness Exercise. Quantile and OLS regression. Quantile and OLS regressions coefficients. Quantile regression: Points and whole line; significant effects: filled points, not significant effects: open points. OLS regression: dotted line, black when significant effect, otherwise grey.

Next, comparing OLS to median regression reveals no substantial differences. However, what is revealed through the QR are systematic differences in the effects of gender and age across the quantiles. The effect of gender is four times higher in the 75 per cent quantile than in the 10 per cent quantile, and the effect of age is clearly higher (more negative) for the lower quantiles. The effect of income is significant only for the median regression, whereas being a student seems to matter to most groups. While the stereotypical understanding of fitness exercise is confirmed in the OLS regression, this picture seems less precise when it comes to those at the lower

levels of the distribution of fitness exercise. This is not because the variables of gender and age do not have significant effects, but because the effects among the low-activity group differ from the effect among those who are more active.

Discussions and conclusions

Given that sport and physical activity are often seen as social goods, the question of social inequality becomes relevant. The common means of studying social inequalities is by adopting statistical methods based on how the mean value of a distribution depends on the values of a set of explanatory variables. Yet the most interesting part of the distribution with respect to physical exercise (and several other distributions of importance when it comes to social inequality) is seldom the mean, but the lower quantiles. Hence, in this article, I have applied a method – quantitative regression (QR) – that captures how a set of independent variables matter for not only the mean value of dependent variables, but also for a selection of the quantiles of its distribution. This offers insights into how a range of variables matter for physical exercise at different levels of activity (quantiles of the distribution), and should be of greater assistance in understanding differences in exercise activity than ordinary OLS regression. This is especially true when trying to reach those whose physical activity level is below the mean, at the point where one distinguishes between those who are fit enough and those who are not yet fit. In this article, I have applied this method to the theme of physical exercise in a Norwegian setting, but the aim has also been more explicit, specifically to demonstrate how the QR provides insights into the question of social inequality and its relationship to physical exercise in a manner unavailable through ordinary regression methods.

A factor analysis identified the three most common forms of exercise (local, association-based, fitness), and ordinary OLS regression and QR for the quantiles 0.10, 0.25, 0.50, 0.75 and 0.90 were conducted for each type of activity, with a selection of independent variables. On a general level, the results demonstrate some of the complexity of physical exercise in modern societies; people are active in different settings or arenas, and different social inequality mechanisms are in operation within these different arenas. This finding also indicates the many actors – public authorities, voluntary organisations and businesses – that should be involved in developing this field.

For scientific and theoretical purposes, the most important contribution of this study is a more finely tuned understanding of social inequalities in sport and physical exercise, particularly in terms of how social differences depend on which point of a distribution – which level of exercise in focus – one looks at. Briefly, some examples include the case of exercising locally, where age is significant in the OLS analysis, but where the QR indicates that age primarily is important at the higher, rather than median, levels of exercise. For fitness exercise, we see that income is OLS-significant,

but in quantile analyses this effect seems restricted to the median. Moreover, QR shows not only that the importance of various independent variables differ between various levels, it also reveals how the extent of the effects vary between quantiles. For associational sports, we see this trend for education, where the effect increases by each quantile (except for the last), meaning the effect at the 75 per cent quantile is more than three times the effect at the 10 per cent quantile (Figure 2a). For fitness exercise, there are clear indications of such variations in effects for both age and gender (Figure 3b), which increases (although negatively for age) for both.

Our findings open up at least two approaches for practical and political aims: decreasing social inequalities and/or increasing levels of physical activity. For the first approach, reducing social inequalities, gender differences could provide an example. For associational sports, gender differences seem less important, but for both local exercise and fitness, our results represent clear specifications of familiar findings. The familiarity comes from women being more active than men in these arenas, and the specifications tell us that gender differences are more apparent for those most active in these settings. If aiming to reduce social inequality (without reducing action), the most immediate and general strategy would appear to involve making fitness (or local facilities) more attractive to men, but even then particularly aiming at those exercising more than average.

However, these indications could prove somewhat schematic for practical purposes – there is a question of how to do this – and useful public policies and voluntary/business strategies require more substantive and contextual knowledge to succeed. Substantively speaking, how do various groups of people actually experience various exercise activities? In contextual terms, how does partaking in one type of activity relate to other activities? From this follows a further question: how will the increased attractiveness of one type of activity for one group (men) influence the attractiveness for a second group (women). In addition, what will happen to the overall pattern of inequalities?

With regard to the second potential approach, the aim to achieve a general increase in exercise and sport, the findings of this article offer two observations. On the one hand, it seems that, for several of the types of activities for which we have data, the differences between social groups in terms of the low-level activities are relatively insignificant and probably not very important. On the other hand, with social differences increasing with higher levels of activity, one should be aware that preparing for increased activity might, realistically, demand more differentiated strategies depending on which social groups are being targeted.

This reveals a potential conflict between the two approaches outlined above. Reducing inequality could come at the cost of decreasing level of activity; alternatively, increasing the level of activity could imply (greater) social inequality. The choice of policies and strategies will also imply a normative question – what types of

social inequalities do we accept when it comes to exercise? – because, as is apparent from this data, there are clear tendencies for various social groups to be attracted to certain forms of physical activity.

Finally, the findings signal what is required of further research. QR provides more detailed insights into patterns of physical activity and social inequalities than traditional OLS regression, but in doing so also points towards a need for more substantive research; for example, how do people actually experience and make sense of their physical activity? In practice, this means that quantitative research should be supplemented by qualitative studies. However, there is also room for improved quantitative studies to address the question of various forms of physical activity, particularly how ‘deliberate exercise’ goes together with other everyday types of physical activity. There is also the perpetual question of how to measure physical activity, and what types of social differences to include in these studies: which aspects of family and working life do really make a difference for physical activity? Finally, to get a better understanding of the policy aspects visited in this article, one could conduct policy experiments with respect to physical activity – testing out various policy tools in different contexts – to establish how various groups of people respond to such policies in light of the type of activity and their social characteristics.

References

- Andersen, R. (2008). *Modern Methods for Robust Regression*. Los Angeles: Sage.
- Bairner, A. (2007). Back to Basics: Class, Social Theory, and Sport. *Sociology of Sport Journal*, 24, 20-36.
- Beenackers, M. A., Kamphuis, C. B., Giskes, K., Brug, J., Kunst, A. E., Burdorf, A., & Van Lenthe, F. J. (2012). Socioeconomic inequalities in occupational, leisure-time, and transport related physical activity among European adults: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, 9(116).
- Bennett, T. (2009). *Culture, class, distinction*. London: Routledge.
- Bergman, P., Grijbovski, A. M., Hagströmer, M., Bauman, A., & Sjöström, M. (2008). Adherence to physical activity recommendations and the influence of socio-demographic correlates – a population-based cross-sectional study. *BMC Public Health*, 8(367).
- Bergsgard, N. A., Mangset, P., Houlihan, B., Nødland, S. I., & Rommetvedt, H. (2007). *Sport Policy: A Comparative Analysis of Stability and Change*. Amsterdam: Butterworth-Heinemann.
- Berk, R. A. (2004). *Regression Analysis: A Constructive Critique*. Thousand Oaks, Calif.: Sage Publications.
- Berk, R. A. (2008). *Statistical Learning from a Regression Perspective*. New York, NY: Springer-Verlag New York.

- Bourdieu, P. (1978). Sport and Social Class. *Social Science Information*, 17(6), 819-840.
- Bourdieu, P. (1990). Programme for a sociology of sport. In P. Bourdieu (Ed.), *In Other Words. Essays Towards a Reflexive Sociology*. Cambridge: Polity Press.
- Breivik, G. (2013). *Jakten på et bedre liv. Fysisk aktivitet i den norske befolkningen 1985-2011*. [The quest for a better life. Physical activity in the Norwegian population 1985-2011] Oslo: Universitetsforlaget.
- Breivik, G., & Hellevik, O. (2013). *More active and less fit: changes in physical activity in the adult Norwegian population from 1985 to 2011*. *Sport in Society*, 1-19. doi: 10.1080/17430437.2013.790898
- Cachay, K., & Hartmann-Tews, I. (Eds.). (1998). *Sport und soziale Ungleichheit*. [Sport and social inequality] Stuttgart: Verlag Stephanie Naglschmid.
- Chan, T. W., & Goldthorpe, J. H. (2007). Class and Status: The Conceptual Distinction and its Empirical Relevance. *American Sociological Review*, 72(4), 512-532.
- Crossley, N. (2006). In the Gym: Motives, Meaning and Moral Careers. *Body & Society*, 12(3), 23-50.
- Dahl, E., & Birkelund, G. E. (1999). *Sysselsetting, klasse og helse 1980-1995. En analyse av fem norske levekårsundersøkelser*. [Employment, class and health 1980-1995. An analysis of five Norwegian surveys of living conditions] Oslo: FAFO rapport.
- Danielsen, Ø. (1989). *Den nye breddeidretten*. [The new mass sport] Oslo: FAFO rapport nr. 88.
- Donnelly, P. (1996). Approaches to Social Inequality in the Sociology of Sport. *Quest*, 48(2), 221-242.
- Dunning, E. (1999). *Sport Matters. Sociological Studies of Sport, Violence and Civilization*. London: Routledge.
- Dølvik, J. E. (1990). *Idrett, fritid og organisering*. [Sport, leisure and organisation] Oslo: FAFO-rapport nr. 99.
- Dølvik, J. E., Danielsen, Ø., & Hernes, G. (1988). *Kluss i vekslinga. Fritid, idrett og organisering*. [Trouble with the shifts. Leisure, sport and organisation] Oslo: FAFO-rapport nr. 80.
- Elstad, J. I. (2000). *Social inequalities in health and their explanations*. Oslo: Norwegian Social Research – NOVA (Report 9/00).
- Enjolras, B., & Wollebæk, D. (2010). *Frivillige organisasjoner, sosial utjevning og inkludering*. [Voluntary organisations, social equality and inclusion] Oslo: Institutt for samfunnsforskning, 2:2010.
- Fasting, K. (2008). *Likestilling og mangfold i norsk idrett: – bedre med flere på banen!* [Gender equality and diversity in Norwegian Sports – more is better!] Oslo: Likestillings- og diskrimineringsombudet.
- Fox, J. (2008). *Applied Regression Analysis and Generalized Linear Models*. (2nd Ed.) London: Sage.

- Goertz, G., Hak, T., & Dul, J. (2012). Ceilings and Floors: Where Are There No Observations? *Sociological Methods & Research*, 42(1), 3-40.
- Goksøyr, M. (2008). *Historien om norsk idrett*. [The History of Norwegian Sports] Oslo: Abstrakt forlag.
- Gruneau, R. (1999). *Class, Sports and Social Development*. Champaign, Ill.: Human Kinetics.
- Guttman, A. (2004). *Sports. The First Five Millennia*. Amherst, Mass.: University of Massachusetts Press.
- Hao, L., & Naiman, D. Q. (2007). *Quantile Regression*. London: Sage.
- Hargreaves, J. (1994). *Sporting Female. Critical Issues in the History and Sociology of Women's Sport*. London: Routledge.
- Hartmann-Tews, I., & Pfister, G. (Eds.). (2003). *Sport and Women. Social Issues in International Perspective*. London: Routledge.
- Hedström, P. (2005). *Dissecting the Social: On the Principles of Analytical Sociology*. Cambridge: Cambridge University Press.
- Helsedirektoratet. (2014). *Anbefalinger om kosthold, ernæring og fysisk aktivitet*. [Recommendations on diet, nutrition and physical activity] Oslo: Helsedirektoratet: Rapport IS-2170.
- Houlihan, B., & Lindsey, I. (2013). *Sport policy in Britain*. New York: Routledge.
- Hovemann, G., & Wicker, P. (2009). Determinants of sport participation in the European Union. *European Journal for Sport and Society*, 6(1), 51-59.
- Koenker, R. (2005). *Quantile Regression*. Cambridge: Cambridge University Press.
- Lüschen, G. (1984). Status Crystallization, Social Class, Integration and Sport. *International Review for the Sociology of Sport*, 19(3-4), 283-294.
- Mandell, R. D. (1984). *Sport. A Cultural History*. New York: Columbia University Press.
- Morgan, W. J. (1994). *Leftist Theories of Sport. A Critique and Reconstruction*. Urbana: University of Illinois Press.
- Piketty, T., & Goldhammer, A. (2014). *Capital in the twenty-first century*. Cambridge, Mass.: Belknap Press.
- R Development Core Team. (2014). R Core Team. R: *A language and environment for statistical computing*. Vienna, Austria: <http://www.R-project.org>.
- Scheerder, J. (2011). Social stratification in adults' sports participation from a time-trend perspective. *European Journal for Sport and Society*, 8(1/2), 31-44.
- Scheerder, J., Vanreusel, B., & Taks, M. (2005). Stratification Patterns of Active Sport Involvement Among Adults. *International Review for the Sociology of Sport*, 40(2), 139-162.
- Scheerder, J., Vanreusel, B., Taks, M., & Renson, R. (2002). Social Sports Stratification in Flanders 1969-1999: Intergenerational Reproduction of Social Inequalities? *International Review for the Sociology of Sport*, 37(2), 219-246.

- Smith Maguire, J. (2007). *Fit for consumption: Sociology and the business of fitness*. London: Routledge.
- Stewart, B., Nicholson, M., Smith, A., & Westerbeek, H. (2004). *Australian sport – better by design?: the evolution of Australian sport policy*. London: Routledge.
- Stokvis, R. (2011). Social stratification and sports in Amsterdam in the 20th century. *International Review for the Sociology of Sport*, 47(4), 511-525.
- Studer, F., Schlesinger, T., & Engel, C. (2011). Socio-economic and cultural determinants of sports participation in Switzerland from 2000 til 2008. *European Journal for Sport and Society*, 8(3), 147-166.
- Sugden, J., & Tomlinson, A. (2000). Theorizing Sport, Social Class and Status. In J. Coakley & D. E. (Eds.), *Handbook of Sport Studies*. London: Sage.
- Taniguchi, H., & Shupe, F. L. (2014). Gender and family status differences in leisure-time sports/fitness participation. *International Review for the Sociology of Sport*, 49(1), 65-84.
- Thrane, C. (2001). Sport Spectatorship in Scandinavia: A Class Phenomenon? *International Review for the Sociology of Sport*, 36(2), 149-164.
- Tomlinson, M. (2004). Lifestyle and Social Class. *European Sociological Review*, 19(1), 97-111.
- Ulseth, A.-L. B. (2004). Social Integration in Modern Sport: Commercial Fitness Centres and Voluntary Sports Clubs. *European Sport Management Quarterly*, 4, 95-115.
- Vaage, O. F. (2009). *Mosjon, friluftsliv og kulturaktiviteter. Resultater fra Levekårsundersøkelsene fra 1997 til 2007* (Vol. 15). [Exercise, recreation and cultural activities. Results from the Survey of Living Conditions from 1997 to 2007] Oslo: Statistisk sentralbyrå • Statistics Norway.
- Van Tuyckom, C. (2011). Macro-environmental factors associated with leisure-time physical activity: A cross-national analysis of EU countries. *Scandinavian Journal of Public Health*, 39, 419-426.
- Van Tuyckom, C., Scheerder, J., & Bracke, P. (2010). Gender and age inequalities in regular sports participation: A cross-national study of 25 European countries. *Journal of Sport Sciences*, 28(10), 1077-1084.
- Veenstra, G. (2007). Who the Heck Is Don Bradman? Sport Culture and Social Class in British Columbia, Canada. *The Canadian Review of Sociology and Anthropology*, 44(3), 319-343.
- Warburton, D. E. R., Nicol, C. W., & Bredin, S. S. D. (2006). Health benefits of physical activity: the evidence. *Canadian Medical Association Journal*, 174(6), 801-809. doi: 10.1503/cmaj.051351
- Warde, A. (2006). Cultural Capital and the Place of Sport. *Cultural Trends*, 15(2-3), 107-122.
- Weeden, K. A., & Grusky, D. B. (2005). The Case for a New Class Map. *American Journal of Sociology*, 111(1), 141-212.

- Williams, S. J. (1995). Theorising Class, Health and Lifestyles: Can Bourdieu Help us? *Sociology of Health & Illness*, 17(5), 577-604.
- Young, C. (2009). Model Uncertainty in Sociological Research: An Application to Religion and Economic Growth. *American Sociological Review*, 74(3), 380-397.

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