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The relationship between physical work and the height premium: Finnish evidence

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ABSTRACT

This paper examines the role of physical strength in the determination of the height wage premium by using the "Health 2000 in Finland" data that contain both self-reported information on the physical strenuousness of work, and information on muscle mass from medical examinations. The results suggest that there are generally no distinct differences in the height premium between four different work strain categories. We also find that muscle mass is positively associated with wages *per se*. The premium is both statistically and economically more significant for men than for women. In terms of occupational sorting, we observe that the shortest men do physically very demanding work and the tallest do sedentary work, even after controlling for the influences of age and education.

1. Introduction

Non-economic attributes such as beauty and weight are widely rewarded in the labour market (Berggren et al., 2010; Bodenhorn et al., 2010; Hamermesh and Biddle, 1994; Komlos, 1990; Mocan and Tekin, 2010). Several empirical studies document the fact that height has a statistically and economically significant positive influence on labour market outcomes such as earnings (Cinnirella and Winter, 2009; Heineck, 2005; Hübler, 2009; Judge and Cable, 2004; Kortt and Leigh, 2010; Schultz, 2002, 2003).[1] There are many potential explanations for this observation. Some authors argue that the pattern arises because height is associated with non-cognitive skills such as social skills (Persico et al., 2004). Others maintain that cognitive skills are more important contributors to the height wage premium. In particular, Case and Paxson (2008a,b) argue that 30–50% of the height premium can be attributed to cognitive ability that is measured in childhood and youth.

Moreover, Lundborg et al. (2009) argue that the positive effect of height on earnings can largely be explained by the fact that there is a positive association between height and physical capacity.[2] They demonstrate that physical capacity explains 80% of the observed height premium in Sweden. They suggest that physical capacity is both a health marker,

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[1] Cohen (2009) has popularized this research. Deaton and Arora (2009) show that taller persons are also happier.

[2] Lundborg et al. (2009) measure physical capacity by using information on maximum oxygen uptake.

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and is considered more attractive, and is therefore a signal of personality traits in demand.

Furthermore, there is evidence that individuals who are engaged in leisure sport activities receive higher wages (Cornelißen and Pfeifer, 2010; Ewing, 1998; Lechner, 2009; Rooth, 2010; Stevenson, 2010).[3] This premium is not related to specific, physically demanding job tasks, but it could, for instance, reflect the fact that individuals with better fitness can endure more effective working hours or have fewer sickness absence days. Also, taller people have greater authority in management and hence they receive higher wages (Herpin, 2005). In brief, the height premium can be due to social skills, cognitive abilities, health, physical strength, authority, and discrimination. While our data set is not sufficient to test between these six aspects, we shall examine how the height premium is related to the extent to which work is physically demanding.

We contribute to the debate by examining the influences of height on wages at different levels of the physical strenuousness of work using the "Health 2000 in Finland" data that incorporate self-reported information on the physical strenuousness of work.[4] One would expect the height premium to be larger for sedentary workers, because the underlying causes of the height premium have generally a greater impact in sedentary work. Thus, height is more of an advantage for managers, lawyers, etc. Furthermore, the data contain information on individuals' muscle mass from medical examinations. Muscle mass is one of the direct measures of individuals' physical capacity.[5]

2. Data and variables

The data set has been constructed in order to give a comprehensive description of the health and functional ability of the Finnish population above the age of 30 (Aromaa and Koskinen, 2004).[6] The data set comes from a random sample of 10,000 individuals from the entire country, the information was collected between September 2000 and June 2001 by means of personal interviews, telephone interviews, and professional health examinations. 88% of the sample persons were interviewed, 80% attended a comprehensive health examination and 5% attended a condensed examination at home. The most essential information on health and functional capacity was obtained from 93% of the subjects.

As we examine the role of the physical strenuousness of work as a potential determinant of the height premium, it is natural to focus on those individuals who are working. Thus, we have limited our focus to wage and salary earners aged between 30 and 64 who work at least 29 h per week.[7] We exclude students, retired,[8] unemployed, those who are doing work only at home, part-time workers and those who do not have positive earnings. We also exclude self-employed persons. (The share of the self-employed in the labour force in Finland is ~7%.)[9] The final working sample size that we use is ~2500.

Annual individual wage data originating from the Finnish tax authorities have been linked to the Health 2000 data set by Statistics Finland, using the personal identification number that every person residing in Finland has.[10] The stratified sampling framework is accounted for in the empirical analyses, as we use survey data methods and appropriate weights in estimations.

The respondents were given four alternative answers with examples of typical occupations in each of them.[11] The first alternative was chosen if the person had *sedentary work:* a job involving little walking during a typical working day. (Examples include watchmaking and office work.) Sedentary work is used as a reference group in the estimations. The second alternative involved jobs that entailed quite a lot of walking, but no lifting or carrying of heavy objects. (The examples include supervising and *light manufacturing work.*) The third alternative was for jobs involving a lot of walking and lifting. (The examples include carpentry and *heavy manufacturing work*.) The fourth alternative included *physically very demanding work* involving lifting and carrying heavy objects. (The examples include logging and heavy farm work.)

The data set also contains information on height and individual body composition measurements from professional health examinations that were conducted at local health centres. The measures of body composition are obtained from an eight-polar bioelectrical impedance analysis, which is performed by running a small constant current through the body (Scharfetter et al., 2004). Resistance, or impedance, is higher in fat than in other types of tissue, which makes it possible to calculate the proportion of fat mass and muscle mass in the body. Measures of body composition have rarely been used in the literature that has analysed the effects of non-economic attributes on labour market outcomes (Burkhauser and

[3] Also, sports are physically strenuous and sportsmen are taller than most subpopulations (Saint-Onge et al., 2008) and they get more pay.

[4] Lantzsch and Schuster (2009) observe significant height differences between occupational groups of conscripts in a historical context. They find that conscripts doing manual work are generally shorter than those with non-manual occupations. Lindqvist (2010) shows that tall men are significantly more likely to attain managerial positions.

[5] Lundborg et al. (2009) also used information on objectively measured muscle strength.

[6] The data set is available from the National Institute for Health and Welfare in Finland (see http://www.terveys2000.fi/indexe.html).

[7] The effective sample size before the restrictions is 7998. 3515 of these persons are wage and salary earners aged between 30 and 64.

[8] The official retirement age in Finland is 64. However, the actual retirement age is approximately 60 years.

[9] Furthermore, it is useful to note that people aged 80 or over in the data were over-sampled with a double inclusion probability relative to the younger age groups.

[10] The data set originates from the Finnish tax administration (see http://www.vero.fi/). Many of the earlier studies on height premium have used survey-based information on earnings that is prone to non-response and reporting bias. However, Lundborg et al. (2009) use register data on wages.

[11] The exact wording of the question is "Could you characterize your current work in terms of physical strenuousness by choosing one of the following alternatives?". The description of each answering categories 1–4 in the main text is the same as the wording that was presented to the respondents of "Health 2000 in Finland" at the time of the interview.

Table 1
Descriptive statistics of the variables.

	Women		Men	
	Mean	Std. dev.	Mean	Std. dev.
Gross hourly wages (€)	7.70	2.96	9.38	7.37
Logarithm of hourly wages	1.99	0.31	2.14	0.42
Height (cm)	164.37	6.22	177.89	6.61
Weight (kg)	69.60	13.26	84.48	13.89
Muscle mass (kg)	45.15	5.43	63.09	8.00
Sedentary work	0.43	0.49	0.41	0.49
Light manufacturing work	0.29	0.45	0.24	0.43
Heavy manufacturing work	0.24	0.43	0.22	0.42
Physically very demanding work	0.03	0.17	0.12	0.33
Age (years)	44.04	8.08	43.44	8.14
High education	0.19	0.39	0.16	0.36
Middle education	0.57	0.50	0.45	0.50
Low education	0.24	0.43	0.39	0.49
N	1259		1247	

Notes: The hourly wages are calculated as an individual's annual wage divided first by 52, and then by the individual's self-reported number of weekly working hours. The classification for the physical strenuousness of work is explained in the text. These are reported as proportions. High education refers to tertiary education, according to the ISCED 1997 classification. Middle education refers to at least upper secondary education, but not tertiary education. Low education refers to less schooling than upper secondary education. Educational levels are also reported as proportions.

Cawley, 2008; Burkhauser et al., 2009; Wada and Tekin, 2010).[12] In the data, muscle mass is reported at the same time as wages.

The share of workers in physically very demanding work is strikingly different between women and men: it is 3% and 12%, respectively (Table 1). Moreover, women are, on average, better educated than men. There is also a negative association between the physical strenuousness of work and wages (Table 2).[13]

Table 2
The mean level of hourly wages (€) at different levels of the physical strenuousness of work.

	Women	Men
Sedentary work	8.35	11.16
Light manufacturing work	7.80	9.31
Heavy manufacturing work	6.94	7.69
Physically very demanding work	6.71	7.01
N	1259	1247

Source: The Health 2000 in Finland population survey.

There is a statistically significant positive correlation between wages and height that is consistent with the existence of the overall height premium (Table 3). There is also a statistically significant correlation between wages and muscle mass as well as between height and muscle mass.

One important limitation of our study is that information on physical workloads is self-reported. Therefore, it is possible that systematic measurement error emerges, because what is reported as a strenuous job may depend on the person's height, if height is related to physical capacity. Taller persons would then, due to their greater physical capacity, report a lower amount of physical strenuousness in a given job than shorter persons. That being said, it is important to note that the question that we use is not in the general form "Is your current job physically strenuous?". But the question does involve detailed examples of occupations that come under each of the four categories. These examples of occupations were mentioned to the respondents at the time of the interview. This should reduce the bias in our self-reported measure of the physical strenuousness of work.[14]

The data have also other shortcomings. First, we use cross-sectional data. Thus, we are unable to estimate fixed effects models that would account for unobservable heterogeneity at the individual level. Second, we do not estimate causal effects and address the possibility that the physical strenuousness of work may be endogenous, i.e. that people of lower physical capacity report a higher level of physical work strain. Third, the endogeneity problems make it difficult to interpret the estimates, because tall and short people are likely to select into occupations of different physical workloads and these selections may reflect decisions that individuals make. For example, a short person who selects into a very physically demanding job may have unsually high unobserved physical skills. As a result of this endogeneity problem, one may get a seriously downwardly biased estimate of the height premium at

[12] Wada and Tekin (2010) estimate models for wages that include fat-free mass as an explanatory variable. They observe that fat-free mass is associated with an increase in the wages of white men and white women.

[13] This points out that there are no compensating wage differentials for physically very demanding work. The data do not contain information about the number of months that a person has been employed during the past year. This most likely explains the low level of gross hourly wages observed in the data.

[14] The same question about the physical strenuousness of work is also incorporated in the National FINRISK Study, which is Finnish individual micro-data at five-year intervals over the period 1972–2002. The changes in the shares of jobs that belong to different work strain categories largely replicate the changes in occupational structure, as documented by Statistics Finland. The respondents seem to anchor their answers to the examples of occupations that were mentioned to them at the time of the interview.

Table 3
Correlations of the variables.

	Logarithm of hourly wages	Height	Weight	Muscle mass
Panel A: Women				
Logarithm of hourly wages	1			
Height	0.095***	1		
Weight	0.012	0.258***	1	
Muscle mass	0.048*	0.627***	0.831***	1
Panel B: Men				
Logarithm of hourly wages	1			
Height	0.118***	1		
Weight	0.079***	0.441***	1	
Muscle mass	0.076***	0.704***	0.870***	1

* $p < 0.1$, statistical significance.
*** $p < 0.01$, statistical significance.

Table 4
The relationship between height, muscle mass and wages. Estimation method: OLS, dependent variable is logarithm of hourly wages.

Sample	Women	Men
	(1)	(2)
Panel A: Height premium		
Constant	0.495 (0.327)	0.499 (0.415)
Height	0.00390*** (0.00121)	0.00666*** (0.00162)
Controls		
Age	0.0281*** (0.0102)	0.00869 (0.0161)
Age squared	−0.000242** (0.000113)	−1.42e−05 (0.000186)
High education	0.368*** (0.0263)	0.412*** (0.0333)
Middle education	0.0853*** (0.0170)	0.0948*** (0.0236)
R^2	0.196	0.144
N	1259	1247
Panel B: Muscle mass premium		
Constant	1.073*** (0.234)	1.403*** (0.342)
Muscle mass	0.00249* (0.00133)	0.00423*** (0.00132)
Controls		
Age	0.0263*** (0.0101)	0.00993 (0.0160)
Age squared	−0.000229** (0.000113)	−3.67e−05 (0.000184)
High education	0.375*** (0.0263)	0.425*** (0.0333)
Middle education	0.0872*** (0.0170)	0.0992*** (0.0235)
R^2	0.192	0.140
N	1259	1247

Notes: The reference category is low education; robust standard errors in parentheses.
* $p < 0.1$.
** $p < 0.05$
*** $p < 0.01$.

different levels of workloads. Fourth, the analyses lack some useful control variables such as parental education and parental height.

3. Empirical approach and results

To explore potential differences in the height premium between different work strain categories we estimate models of the form:

$$\log \text{wage}_i = \beta_0 + \beta_1 Height_i + \beta_2 D(Strenuous_i) + \beta_3 Height_i \times D(Strenuous_i) + \boldsymbol{\beta}_4 \boldsymbol{X}_i + \varepsilon \quad (1)$$

$D(.)$ denotes four indicator variables and i refers to an individual. $\boldsymbol{X}$ is a vector of individual-level control variables including age, age squared and education. In Eq. (1) the variables of our main interest are the interactions between height and the four indicators of the physical strenuousness of work. In an alternative specification of the model, we use the measure of muscle mass, based on bioelectrical impedance analysis, instead of the different levels of the physical strenuousness of work, because muscle mass is a direct objective measure of physical capacity. We report all estimates separately for men and women, because of the social norm and occupational structure differences between men and women. Our expectation is that physical capacity should be a more important determinant of men's wages.

We document the existence of the overall height premium in Finland by using specifications that do not

Table 5
The relationship between height, the physical strenuousness of work and wages. Estimation method: OLS, dependent variable is logarithm of hourly wages.

Sample	Women	Men
	(1)	(2)
Constant	0.777* (0.402)	0.787 (0.489)
Height	0.00260 (0.00179)	0.00707*** (0.00232)
Light manufacturing work	−0.518 (0.476)	1.159 (0.726)
Heavy manufacturing work	−0.149 (0.413)	−0.000926 (0.732)
Physically very demanding work	−1.516 (1.041)	0.183 (0.964)
Height × light manufacturing work	0.00269 (0.00289)	−0.00719* (0.00412)
Height × heavy manufacturing work	0.000273 (0.00251)	−0.00127 (0.00409)
Height × physically very demanding work	0.00850 (0.00641)	−0.00286 (0.00542)
Controls		
Age	0.0281*** (0.00997)	0.00121 (0.0153)
Age squared	−0.000242** (0.000111)	5.48e−05 (0.000177)
High education	0.330*** (0.0278)	0.270*** (0.0372)
Middle education	0.0663*** (0.0174)	0.0328 (0.0249)
R^2	0.219	0.209
N	1259	1247

Notes: The reference category is sedentary work and low education; robust standard errors in parentheses.
* $p < 0.1$.
** $p < 0.05$
*** $p < 0.01$.

include the indicators for the physical strenuousness of work. The coefficient for height implies that 10 cm extra height for a man is associated with a higher hourly wage of ∼7% (Table 4, Panel A, Column 2).[15] For women the corresponding point estimate is lower at 4% (Table 4, Panel A, Column 1).[16]

We explore the existence of a ''muscle mass premium'' with controls for age and education included. (Weight is not included among the explanatory variables, because there is a strong positive correlation between weight and muscle mass for both women and men, as documented in Table 3.) These results show evidence for the existence of positive muscle mass premium (Table 4, Panel B). The premium is both statistically and economically more significant for men than for women (Table 4, Panel B, Column 2). The coefficient for muscle mass implies that 10 kg more muscle for a man is associated with a higher hourly wage of 4%. For women the point estimate is lower at 2% (Table 4, Panel B, Column 1). The regression results are in accordance with the correlations in Table 3. To explore the existence of nonlinear influences, we divided muscle mass into four discrete categories with each having an equal number of observations. The results reveal that muscle mass has a statistically significant positive influence of ∼10% on wages for men in the highest category of muscle mass.

The estimates of Eq. (1) reveal that the only statistically significant coefficients prevail for men in light manufacturing work (Table 5). For women not even this influence prevails. Taken together, there appears to be no systematic evidence that the height premium is larger for those doing physically more strenuous work.[17] It is important to note that the findings of Lundborg et al. (2009) do not predict that the height premium is largest in work that is physically strenuous. Instead, physical capacity may constitute a sign of good health. This implies that it should be rewarded to a greater extent in higher-paid white-collar occupations. To check the robustness, we have estimated the models in Table 5 by adding weight to the set of controls. The conclusions do not change in this specification. We have also estimated the height premium separately for sedentary male workers and the other three categories of physical strenuousness of work in order to see if height has any effect on wages within these two groups. The point estimates from these specifications suggest that the height premium is somewhat larger for sedentary male workers alone (∼7% for 10 cm extra height) than within the other three categories (∼4%).

The results that include the interaction term for height and muscle mass suggest that the influence of height on wages is not systematically larger for individuals who have a lot of muscle mass, because the interaction term for height and muscle mass is not statistically significant at conventional levels (not reported).[18] The pattern is similar

[15] Johansson et al. (2009) have reported earlier the existence of the height premium by using the Health 2000 data set. The height premium may be related to work at the individual's disposal. This varies geographically, as does the size of the local population. In urban areas the process of selecting work may be more mixed and possibly the effect of height on labour market outcomes is also larger.

[16] We have also estimated the models by using quantile regression. Estimating several quantiles enables us to explore the shape of the conditional distribution, not just its mean. We have estimated the models for the 10th, 25th, 50th and 75th quantiles. The point estimates suggest that the influence of height on wages for both women and men is larger in the highest wage quantiles than at the lower tail of the distribution. However, owing to the relatively small sample size the differences are generally not statistically significant. Lundborg et al. (2009) observe that the return to an additional centimetre in height is larger further away from the median earnings.

[17] It is useful to note that strenuous work does have a large range in the pay scale.

[18] These results are reported in the working paper version. The data is too limited in scope for us to estimate these specifications separately for each of the workload categories.

Table 6
The relationship between the physical strenuousness of work and height. Estimation method: OLS, dependent variable is height.

Sample	Women	Men
	(1)	(2)
Constant	178.8*** (5.283)	165.2*** (5.217)
Light manufacturing work	−0.0913 (0.416)	−1.115** (0.456)
Heavy manufacturing work	−0.209 (0.435)	−1.658*** (0.523)
Physically very demanding work	−0.719 (0.984)	−2.086*** (0.648)
Controls		
Age	−0.530** (0.238)	0.777*** (0.241)
Age squared	0.00419 (0.00264)	−0.0104*** (0.00274)
High education	1.871*** (0.554)	1.084* (0.576)
Middle education	0.659 (0.422)	0.189 (0.416)
R^2	0.060	0.061
N	1259	1247

Notes: The reference category is sedentary work and low education; robust standard errors in parentheses.
* $p < 0.1$.
** $p < 0.05$
*** $p < 0.01$.

for both women and men. However, the inclusion of the highly correlated variables in a limited sample may be hazardous. The correlation coefficient between height and muscle mass is 0.7 for men (Table 3, Panel B). To address the correlation of the continuous explanatory variables, we have also experimented with the specifications that include the indicators for four discrete categories of muscle mass that each have an equal number of observations along with the interactions of these categories with height as the explanatory variables. The interaction terms are not statistically significant in these models.

We estimate OLS regressions of the following form to examine whether there is occupational sorting in terms of height:

$$Height_i = \beta_0 + \beta_1 D(Strenuous_i) + \boldsymbol{\beta_2 X}_i + \varepsilon_i \qquad (2)$$

In Eq. (2) the important independent variables are the four indicators for the physical strenuousness of work. The results reveal that the shortest Finnish male workers do physically very demanding work and the tallest do sedentary work (Table 6, Column 2). In particular, men doing physically very strenuous work are, on average, roughly 2 cm shorter than those doing sedentary work, even after controlling for the influences of age and education. This pattern is not inconsistent with the findings by Lundborg et al. (2009), because they find some evidence that taller men are in higher-paying occupations.[19] For women the pattern is different, i.e. the physical strenuousness of work is not related to height, after taking into account the influences of the control variables (Table 6, Column 1).[20]

4. Conclusions

The height wage premium is widely documented in the literature. This paper contributes to the debate by examining the role of physical strength in the determination of the height premium in the case of Finland. The limitations of the data notwithstanding, the results suggest that there are generally no distinct differences in the height premium between four different work strain categories. The only specifications that indicate that the height premium differs according to the physical strenuousness of work are the ones that are estimated separately for sedentary male workers and the other three categories of physical strenuousness of work. These results suggest that the height premium is somewhat larger for sedentary male workers alone. We also find that muscle mass is positively associated with wages *per se*. The premium is both statistically and economically more significant for men than for women. However, the interaction term for height and muscle mass is not statistically significant. This result suggests that the height premium is not greater for those who have a lot of muscle mass.[21] In terms of occupational sorting, we observe that the shortest men do physically very demanding work and the tallest do sedentary work, even after controlling for the influences of age and education. The prominent explanation for this pattern is that height provides authority that is needed, especially in upper white-collar jobs that are sedentary.

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[19] This pattern can be caused by sorting or it may also be demand driven.
[20] We have also estimated multinomial logit models to explore how height, controlling for age and education, affects the probability of being in one of the four categories of physical strenuousness of work. These results show that an increase in height decreases clearly the probability that individual is at work that is physically very strenuousness, other things being equal.

[21] Muscle mass may not be the best measure of physical capacity. Lundborg et al. (2009) argue that maximum oxygen uptake is a better measure for physical capacity than muscle strength. They find statistically weaker results for objectively measured muscle strength than for maximum oxygen uptake.

on Health Economics (ECHE) in Helsinki. We are grateful to the seminar audience for comments. Paul A. Dillingham has kindly corrected the English language. All the remaining errors are ours.

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