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Low IQ as a predictor of unsuccessful educational and occupational achievement: A register-based study of 1,098,742 men in Denmark 1968–2016

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ABSTRACT

The present register-based study investigated the role of IQ in predicting a wide range of indicators of unsuccessful educational and occupational achievement among young men born across five decades in Denmark. The study population comprised all men who have been born since 1950 and have appeared before a draft board during the periods from 1968 to 1984 and from 1987 to 2015 (N = 1,098,742). IQ was assessed by Børge Priens Prøve at age 18. Unsuccessful educational achievement was indicated by leaving lower secondary school without a certificate, by no completed youth education at age 25, by no completed education leading to vocational qualifications at age 30, and by the total number of interruptions to education at age 30. Unsuccessful occupational achievement was indicated by not being in employment, education or training at age 30, by unemployment at age 30, by receiving sickness benefits at age 30, by receiving welfare benefits at age 30, by receiving disability pension at age 30, and by gross income at age 30. Binary logistic regression, negative binomial regression and median regression were used to estimate the associations of IQ with unsuccessful educational and occupational achievement. The results showed that low IQ was a strong and consistent predictor of all indicators of unsuccessful educational and occupational achievement. In conclusion, the study findings suggest that assessment of intelligence may provide crucial information for educational planning and counselling of poor-functioning schoolchildren and adolescents with regard to both the immediate educational goals and the more distant work-related future.

1. Introduction

Intelligence test score is a well-established predictor of educational and occupational achievement worldwide (Gottfredson, 2003; Neisser et al., 1996; Strenze, 2007). Longitudinal studies typically report correlation coefficients of 0.5–0.6 between intelligence and educational achievement as assessed by educational level or school grades (Deary & Johnson, 2010; Roth et al., 2015; Strenze, 2007), correlation coefficients of 0.4–0.5 between intelligence and occupational level (Gottfredson, 2003; Schmidt & Hunter, 2004; Strenze, 2007) and correlation coefficients of 0.2–0.4 between intelligence and income (Gottfredson, 2003; Strenze, 2007).

Although the above-mentioned associations are well-established, low intelligence still seems to be an overlooked problem among young people struggling to complete an education or gain a foothold in the labour market (Rehermann & Mortensen, 2010). Rather, non-cognitive factors such as family social background are usually the focus of attention when the issue of unsuccessful educational and occupational courses is on the agenda (Rustin, 2015). Non-cognitive factors are obviously important foci of attention, but it seems to be time to broaden the horizon and also look into the possible influence of cognitive resources if the society wants to reduce the proportion of young people with unsuccessful educational and occupational courses.

Currently, the Europe 2020 targets state a commitment among the European Union's member countries to reduce the rates of early school leaving and to reduce the unemployment rates (The European Commission, 2017). Accordingly, the Danish government aims to reduce the proportion of young people without a youth education and to reduce the proportion of young people not in employment, education or training (the so-called NEET indicator) (The Government of Denmark, 2017). These targets are not only important to achieve in order to help the young people who time after time are defeated in the educational

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system or on the labour market, but also to reduce the socio-economic costs due to loss of earnings and welfare benefits. Still, studies focusing specifically on the importance of intelligence in young people with unsuccessful educational and occupational courses are relatively scarce. However, the existing studies consistently demonstrate that low intelligence is significantly associated with lack of school and post-school educational or vocational qualifications and with an increased risk of unemployment, long-term sickness absence, welfare benefits receipt, disability pension and low income (Caspi, Wright, Moffitt, & Silva, 1998; Fergusson, Horwood, & Ridder, 2005; Gravseth et al., 2008; Henderson, Richards, Stansfeld, & Hotopf, 2012; Karnehed, Rasmussen, & Modig, 2015; Upmark, Lundberg, Sadigh, & Bigert, 2001). Most of these studies only focus on a single indicator of an unsuccessful educational or occupational course, for this reason it is not possible to evaluate the role of intelligence in relation to different outcome indicators (Caspi et al., 1998; Gravseth et al., 2008; Henderson et al., 2012; Karnehed et al., 2015; Upmark et al., 2001). Also, most of these studies are based on populations born within a relatively narrow time span. Therefore, it is not possible to investigate time trends in the association of intelligence with unsuccessful educational and occupational achievement. Further, only three of the studies have been conducted in a member country of the European Union and no study has been conducted in Denmark (Henderson et al., 2012; Karnehed et al., 2015; Upmark et al., 2001).

Due to contextual differences with regard to educational system and flexibility and security on the labour market as well as educational and labour market policies, the role of intelligence in predicting unsuccessful educational and occupational courses may vary among countries. As Denmark has free admittance to education at all levels, state financed student grants for all students, and a relatively high support of students with special educational needs, intelligence might be expected to play a larger role – as socioeconomic factors might be of less importance – with regard to educational and occupational achievement compared with countries outside Scandinavia.

The aim of this study was therefore to investigate the role of IQ in predicting a wide range of indicators of unsuccessful educational and occupational achievement among young people born across five decades in Denmark.

2. Materials and methods

2.1. Study population

A register-based cohort study was conducted using a completely new database comprising all Danish men born since 1950 and appearing before a draft board during the periods from 1968 to 1984 and from 1987 to 2015 (N = 1,098,742). Danish men who appeared before a draft board in 1985 and 1986 were not included, as draft board information from these two years still have not been digitized.

All Danish men are subject to compulsory military service and conscripts with residence in the country have to appear before a draft board in the year in which they turn 18 years. However, if the conscripts are undergoing education the compulsory attendance at the draft board can be postponed until the end of the year in which they turn 25 years. At the draft board, the eligibility of the men for military service is determined. The men are either determined to be eligible, limited eligible or unfit for military service based on the results of an intelligence test and a medical examination. During the period from 1995 to 2015, the proportion of men who were determined to be eligible, limitedly eligible or unfit for military service corresponded to 53%, 8% and 39%, respectively (The Defence Command, 2017). For about half of the men who are determined to be unfit for military service, their compulsory military service is cancelled due to documentation of existing health issues forwarded to the draft board (personal communication with Mogens Rosenlund Nielsen, the Danish Defence Personnel Organization). In addition, men who have agreed to serve as volunteers in the military forces before the age of conscription do not appear before a draft board, but this only concerns a few hundred.

According to Danish legislation, no ethics approval is needed for register-based studies. The present study is covered by permissions from the Danish Data Protection Agency to the authors.

3. Variables

3.1. Intelligence

The exposure of interest was intelligence, which was measured by Børge Priens Prøve (BPP) (Teasdale, 2009) when the study population appeared before a draft board.

The BPP is a group-administered intelligence test in paper-and-pencil format. It lasts 45 min and comprises 78 items, which are divided into four subtests: Letter Matrices, Verbal Analogies, Number Series and Geometric Figures. The number of correct answers in each of the four subtests is summed to a total score (range: 0–78). A previous study has found the correlation between the BPP and the full-scale Wechsler Adult Intelligence Scale to be 0.82 (Mortensen, Reinisch, & Teasdale, 1989).

Since 1957, the BPP has been a part of the Danish draft board examinations and results from the conscripts' intelligence tests and medical examinations have been recorded on register cards. For men who appeared before a draft board during the period 1968–1984, the register cards have been digitized and are now stored in the Danish Conscription Database (DCD) (Christensen et al., 2015). For men who appeared before a draft board during the period 1987–2005, the register cards have been digitized and stored in the Danish National Archives' database, but the BPP total score was recoded into 5 categories (Teasdale, 2009). For men who appeared before a draft board during the period 1995–2005 and have been determined to be eligible or limitedly eligible for military service, the BPP total score and other information from the register cards have been digitized and stored in the Danish Defence Personnel Organization's database. Since 2006, all information from the Danish draft board examinations is digitized and stored in the Conscription Register administered by the Danish Health Data Authority.

To make the results of this study easier to compare with the results of other studies, the BPP total score was in the statistical analyses converted to an intelligence quotient (IQ) score with a theoretical mean of 100 and a standard deviation (SD) of 15. First, we calculated the mean and SD of the BPP total score for the years of birth for which we had BPP total scores and complete follow-up at the draft board examinations (i.e. the following years of birth: 1939–1959 and 1988–1996, although in this study we only include men born since 1950). Second, to take secular trends in the mean and SD of the BPP total score into account, using the calculated means and SDs as separate outcomes, linear regression was used to estimate linear, quadratic and cubic associations of year of birth with the mean and SD, respectively. For both the estimated mean and SD, the cubic function was highly significant and explained 96.5% and 98.7% of the variance in the outcome, respectively. Therefore, the two cubic functions were used to calculate the expected means and SDs of the years of birth included in the study (i.e. the following years of birth: 1950–1997). Finally, for each individual in the study population we used the BPP total score and the expected mean and SD for his year of birth to calculate a z score, which was used to derive his IQ score.

3.2. Unsuccessful educational achievement

The first of the two outcomes of interest was the study population's educational achievement in young adulthood. Unsuccessful educational achievement was indicated by leaving lower secondary school without a certificate, by no completed youth education at age 25, by no completed education leading to vocational qualifications at age 30, and by

the total number of interruptions to education at age 30. Information on these indicators of unsuccessful educational achievement was available from Statistics Denmark's registers since 2002, 1981, 1981 and 1973, respectively.

3.3. Unsuccessful occupational achievement

The second of the two outcomes of interest was the study population's occupational achievement in young adulthood. Unsuccessful occupational achievement was indicated by being NEET at age 30, by unemployment at age 30, by receiving sickness benefits at age 30, by receiving welfare benefits at age 30, by receiving disability pension at age 30, and by gross income at age 30. Sickness benefits are for individuals who cannot work because of sickness, but who have had some attachment to the labour market before the notice of sickness. Welfare benefits are for individuals who cannot provide for themselves and their families – thus, it is required that the individual has no wealth and that the spouse cannot provide for one as well. Disability pensions are for individuals who have a substantially and permanently reduced working capacity. In general, individuals below the age of 40 cannot be granted disability pensions unless it is clearly pointless to try to improve their working capacities. Information on the indicators of unsuccessful occupational achievement was available from Statistics Denmark's registers since 1987 - except for information on gross income, which was available since 1980.

3.4. Covariates

Covariates included the study population's year of birth, ethnicity (Danish, non-Danish), birth region (Capital Region of Denmark, Region Zealand, North Denmark Region, Central Denmark Region, Region of Southern Denmark), binary indicators of out-of-home care in childhood, psychiatric diagnoses in childhood, neurological diagnoses in childhood, perinatal diagnoses and congenital deformities (see Supplementary Material 1 for the specific ICD codes), and parental socioeconomic position at birth measured by the parents' total highest educational attainment (low, medium-low, medium-high, high).

4. Statistical methods

Descriptive statistics were used to describe the characteristics of the study population according to IQ.

The missing data frequency was < 3% for all variables, except for parental education at birth and IQ for which the missing data frequency was 3.8% and 27.6%, respectively. However, the majority of individuals without a registered IQ score was registered with the BPP score recoded into 5 categories. Only 0.8% of the study population was not registered with either an IQ score or the recoded BPP score. To handle missing data, all statistical analyses were conducted using multiple imputation. First, the missing data were imputed using chained equations, which is a sequence of univariate imputation methods with fully conditional specification of prediction equations. This process was repeated until 40 complete datasets were created. Second, the statistical models described below were run within each of the imputed datasets. Third, the obtained parameter estimates from all the analysed datasets were combined for inference using Rubin's combination rules. Consequently, all statistical analyses were conducted using multiple imputation in which missing values were generated from the available values on the included variables in each model and analysed using 40 imputed datasets.

The main analyses comprised three statistical methods. With regard to the three indicators of unsuccessful educational achievement – 'no school leaving certificate', 'no youth education' and 'no vocational qualification' – and the five indicators of unsuccessful occupational achievement – 'NEET', 'unemployment', 'sickness benefits', 'welfare benefits' and 'disability pension' – the associations of IQ with unsuccessful educational and occupational achievement were analysed by means of binary logistic regression. With regard to the indicator of unsuccessful educational achievement – 'number of interruptions to education' – the association of IQ with unsuccessful educational achievement was analysed by means of negative binomial regression. Finally, with regard to the indicator of unsuccessful occupational achievement – 'gross income' – the association of IQ with unsuccessful occupational achievement was analysed by means of median regression. For all main analyses, we centred IQ at its mean of 100 and tested whether a linear, quadratic or cubic IQ term best described the association under consideration. All main analyses were conducted by use of two statistical models: An unadjusted model and a model adjusted for year of birth (centred linear, quadratic or cubic term depending on the association under consideration), ethnicity, birth region, parental education at birth, out-of-home care in childhood, psychiatric diagnoses in childhood, neurological diagnoses in childhood, and perinatal diagnoses and congenital deformities. For all statistical models, the potential influence of clustering was taken into account by correcting for intra-cluster dependency. Relevant model assumptions were assessed, but no violations were observed.

In sensitivity analyses, the robustness of the results was controlled: All statistical analyses were thus conducted using non-imputed data on all available cases.

All statistical analyses were carried out using STATA version 14.2.

5. Results

Characteristics of the 1,098,742 men comprising the study population are shown in Table 1. Individuals who differed in IQ score were found to differ with regard to all characteristics – thus, low IQ was found to be associated with belonging to the older birth cohorts, non-Danish ethnicity, being born in Region Zealand or Region of Southern Denmark, parents with lower educational attainment, out-of-home care in childhood, psychiatric diagnoses in childhood, neurological diagnoses in childhood, and perinatal diagnoses and congenital deformities. The far right column of Table 1 shows the characteristics of the individuals who have missing IQ scores: Although it is a large proportion of the study population, 97% of these men are registered with the recoded BPP score, which means that we actually have some information on their IQ scores.

The distribution of unsuccessful educational and occupational achievement according to IQ score is shown in Table 2. Individuals who differed in IQ score were found to differ with regard to all indicators of unsuccessful educational and occupational achievement such that low IQ was associated with a higher proportion of unsuccessful educational and occupational achievement. For example, among the 12.1% of our study population who left lower secondary school without receiving a certificate, 39.7% had an IQ < 80 and 23.1% had an IQ of 80–89, although these individuals only accounted for 7.8% and 13.1% of the total study population.

The main analyses showed that IQ was inversely associated with all indicators of unsuccessful educational and occupational achievement in young adulthood after adjustment for covariates (Figs. 1–3 & Supplementary Tables 1–2). With regard to unsuccessful educational achievement, Fig. 1 shows that the probabilities of no school leaving certificate, no youth education at age 25, and no vocational qualification at age 30 decreased with increasing IQ in a cubic relation, suggesting essentially no or only weak associations at superior IQ levels. IQ had the strongest influence on the probability of no school leaving certificate. Although the probabilities of the three outcome indicators were almost the same among individuals with extremely low IQ, the probability of no school leaving certificate approached zero among individuals with an IQ of 100 or above whereas the probabilities of no youth education at age 25 and no vocational qualification at age 30 remained notably higher. Interestingly, the probability of no vocational qualification at age 30 seemed to increase a little among individuals

Table 1
Characteristics of the study population (N = 1,098,742).

	IQ score			Missing (N = 293,213)
	< 80 (N = 63,165)	80-89 (N = 105,518)	≥ 90 (N = 636,846)	
Year of birth				
Median (IQR)	1974 (1954-1991)	1978 (1955-1989)	1980 (1956-1989)	1973 (1971-1976)
Minimum-maximum	1950-1997	1950-1997	1950-1997	1950-1997
Ethnicity, N(%)				
Danish	56,689 (89.8)	98,373 (93.3)	617,961 (97.1)	283,953 (96.9)
Non-Danish	6,412 (10.2)	7,055 (6.7)	18,593 (2.9)	9,189 (3.1)
Missing	64 (-)	90 (-)	292 (-)	71 (-)
Birth region, N(%)				
Capital Region of Denmark	7,919 (27.3)	16,149 (28.3)	111,576 (28.3)	25,316 (27.1)
Region Zealand	4,858 (16.7)	8,788 (15.4)	52,986 (13.5)	12,701 (13.6)
North Denmark Region	2,763 (9.5)	5,629 (9.9)	38,261 (9.7)	9,624 (10.3)
Central Denmark Region	5,884 (20.3)	12,039 (21.1)	92,239 (23.4)	21,732 (23.3)
Region of Southern Denmark	7,618 (26.2)	14,498 (25.4)	98,828 (25.1)	24,082 (25.8)
Missing	2,464 (-)	2,669 (-)	8,170 (-)	3,704 (-)
Not available	31,659 (-)	45,746 (-)	234,786 (-)	196,054 (-)
Parental education at birth[a], N(%)				
Low	8,873 (33.5)	11,024 (25.1)	38,230 (12.9)	10,203 (29.2)
Medium-low	14,008 (52.9)	24,495 (55.8)	147,721 (49.8)	16,807 (48.1)
Medium-high	3,042 (11.5)	6,948 (15.8)	81,059 (27.4)	6,184 (17.7)
High	578 (2.2)	1,464 (3.3)	29,390 (9.9)	1,762 (5.0)
Missing	3,002 (-)	2,748 (-)	8,000 (-)	2,084 (-)
Not available	33,662 (-)	58,839 (-)	332,446 (-)	256,173 (-)
Out-of-home care in childhood, N(%)				
Yes	2,905 (9.5)	3,709 (6.6)	9,632 (2.6)	5,921 (9.4)
No	27,693 (90.5)	52,571 (93.4)	368,076 (97.5)	57,187 (90.6)
Not available	32,567 (-)	49,238 (-)	259,138 (-)	230,105 (-)
Psychiatric diagnoses in childhood, N(%)				
Yes	620 (2.0)	711 (1.3)	2,319 (0.6)	925 (1.5)
No	29,978 (98.0)	55,569 (98.7)	375,389 (99.4)	62,183 (98.5)
Not available	32,567 (-)	49,238 (-)	259,138 (-)	230,105 (-)
Neurological diagnoses in childhood, N(%)				
Yes	3,931 (12.9)	5,635 (10.0)	29,801 (7.9)	3,508 (5.6)
No	26,667 (87.2)	50,645 (90.0)	347,907 (92.1)	59,600 (94.4)
Not available	32,567 (-)	49,238 (-)	259,138 (-)	230,105 (-)
Perinatal diagnoses and congenital deformities, N(%)				
Yes	2,677 (8.8)	4,376 (7.8)	24,755 (6.6)	4,650 (7.4)
No	27,921 (91.3)	51,904 (92.2)	352,953 (93.5)	58,458 (92.6)
Not available	32,567 (-)	49,238 (-)	259,138 (-)	230,105 (-)

[a] Parental education at birth is categorized as 'low' (primary education), 'medium-low' (upper secondary school, vocational education and training), 'medium-high' (short cycle higher education, vocational bachelors educations, bachelors programs), and 'high' (masters programs, PhD programs).

with an IQ above 115. Although this finding might be a statistical artefact, it could also reflect personality or motivational factors associated with high IQ. Table 3 provides an overview of the estimated probabilities of unsuccessful educational achievement according to IQ score. Fig. 2 shows that the number of interruptions to education at age 30 decreased linearly with increasing IQ. Thus, individuals with an IQ of 70 had 0.72 interruptions, individuals with an IQ of 100 had 0.65 interruptions, and individuals with an IQ of 130 had 0.58 interruptions to education.

With regard to unsuccessful occupational achievement, Fig. 1 shows that the probabilities of NEET at age 30, unemployment at age 30, sickness benefits at age 30, and welfare benefits at age 30 decreased with increasing IQ in a cubic relation and that the probability of disability pension at age 30 decreased with increasing IQ in a quadratic relation, suggesting much weaker associations than for the indicators of unsuccessful educational achievement. Interestingly, the probabilities of NEET at age 30 and welfare benefits at age 30 seemed to increase a little among individuals with an IQ above 115, but as is the case with no vocational qualification at age 30 this might be a statistical artefact. Table 3 provides an overview of the estimated probabilities of unsuccessful educational and occupational achievement according to IQ score permitting a comparison of the influence of IQ on the various indicators of unsuccessful educational and occupational achievement. Gross income at age 30 increased with increasing IQ in a statistically significant cubic relation, although Fig. 3 suggests an almost linear relation. Thus, individuals with an IQ of 70 had a median gross income of 301,347 DKK, individuals with an IQ of 100 had a median gross income of 331,854, and individuals with an IQ of 130 had a median gross income of 363,089 DKK – in the beginning of June 2018 corresponding to about 47,856 USD, 52,701 USD, and 57,662 USD, respectively.

In supplemental analyses, we investigated possible time trends in the associations of IQ with unsuccessful educational and occupational achievement by comparing the observed associations across different birth decades (1950s, 1970s and 1980s). However, no consistent time trends were found (Supplementary Figs. 1–3 & Supplementary Table 3). Further, we investigated the influence of IQ on the transition from education to labor market at ages 18–30. The results showed that among individuals undergoing education, low IQ was associated with a higher hazard rate of passing to employment, unemployment, sickness benefits receipt and welfare benefits receipt (results not shown). This indicates that individuals with low IQ tend to leave the educational system to find employment at a younger age than individuals with high IQ, but that this early leave from the educational system often is associated with a transition into unemployment, sickness benefits receipt and welfare benefits receipt.

Sensitivity analyses revealed no significant changes in the associations of IQ with unsuccessful educational and occupational achievement by use of available case analyses.

Table 2
Unsuccessful educational and occupational achievement according to IQ score (N = 1,098,742).

	IQ score			
	< 80	80–89	≥ 90	Missing
	(N = 63,165)	(N = 105,518)	(N = 636,846)	(N = 293,213)
No school leaving certificate, N(%)				
Yes	13,153 (50.6)	7657 (20.6)	12,329 (5.4)	2777 (34.2)
No	12,846 (49.4)	29,443 (79.4)	216,999 (94.6)	5344 (65.8)
Not available	37,166 (−)	68,418 (−)	407,518 (−)	285,092 (−)
No youth education at age 25, N(%)				
Yes	17,794 (61.0)	24,018 (42.1)	76,624 (19.8)	88,399 (30.5)
No	11,389 (39.0)	32,986 (57.9)	309,564 (80.2)	201,914 (69.6)
Not available	33,982 (−)	48,514 (−)	250,658 (−)	2900 (−)
No vocational qualification at age 30, N(%)				
Yes	21,081 (63.0)	26,723 (41.1)	108,691 (27.2)	100,720 (34.7)
No	12,393 (37.0)	38,376 (59.0)	291,003 (72.8)	189,172 (65.3)
Not available	29,691 (−)	40,419 (−)	237,152 (−)	3321 (−)
Number of interruptions to education at age 30, N(%)				
0 interruptions	2742 (48.3)	13,929 (53.1)	115,901 (58.7)	173,578 (60.3)
1 interruption	1615 (28.4)	7420 (28.3)	53,669 (27.2)	80,094 (27.8)
≥2 interruptions	1323 (23.3)	4895 (18.7)	27,805 (14.1)	33,990 (11.8)
Not available	57,485 (−)	79,274 (−)	439,471 (−)	5551 (−)
NEET at age 30, N(%)				
Yes	2612 (21.6)	5518 (15.9)	23,230 (9.8)	40,524 (14.2)
No	9501 (78.4)	29,256 (84.1)	214,919 (90.3)	244,616 (85.8)
Missing	172 (−)	179 (−)	699 (−)	67 (−)
Not available	50,880 (−)	70,565 (−)	397,998 (−)	8006 (−)
Labor market attachment at age 30, N(%)				
Employment	9484 (78.9)	29,139 (84.8)	213,910 (91.0)	242,789 (87.1)
Unemployment	1018 (8.5)	1503 (4.4)	5733 (2.4)	8158 (2.9)
Sickness benefits	208 (1.7)	514 (1.5)	2281 (1.0)	3797 (1.4)
Welfare benefits	1031 (8.6)	2772 (8.1)	11,978 (5.1)	20,148 (7.2)
Disability pension	275 (2.3)	425 (1.2)	1078 (0.5)	3790 (1.4)
Missing	269 (−)	600 (−)	3868 (−)	6525 (−)
Not available	50,880 (−)	70,565 (−)	397,998 (−)	8006 (−)
Gross income at age 30				
Mean (SD)	279,746 (383,042)	303,711 (148,929)	340,114 (308,982)	334,338 (392,668)
Missing, N	813	1315	6756	6562
Not available, N	27,116	36,939	227,621	6653

Abbreviations: NEET, Not In Employment, Education or Training.

6. Discussion

6.1. Main findings

The results showed that low IQ was a strong predictor of all indicators of unsuccessful educational and occupational achievement. Specifically, the probability of leaving lower secondary school without a certificate, the probability of not having completed a youth education at age 25, the probability of not having completed an education leading to vocational qualifications at age 30, and the number of interruptions to education at age 30 was found to decrease with increasing IQ. The probability of being NEET at age 30, the probability of unemployment at age 30, the probability of sickness benefits at age 30, the probability of welfare benefits at age 30, and the probability of disability pension at age 30 was also found to decrease with increasing IQ, whereas gross income at age 30 was found to increase with increasing IQ. Overall, it seemed that IQ had the strongest influence on the risk of unsuccessful educational achievement and on the risk of disability pension, and that the influence of IQ on educational achievement was strongest in the early educational career and decreased over time. No consistent time trends in the investigated associations were found.

6.2. Comparison with the existing literature

The finding that IQ is a strong predictor of educational and occupational achievement is consistent with the existing literature, including a large meta-analysis of 65 studies (Strenze, 2007).

Although no previous studies, to our knowledge, have investigated whether low IQ is associated with a higher risk of leaving lower secondary school without receiving a certificate, several studies have found positive associations between intelligence and examination grades (Deary, Strand, Smith, & Fernandes, 2007; Krapohl et al., 2014; Strand, 2006), as well as intelligence and grades for general proficiency (Laidra, Pullmann, & Allik, 2007; Zuffianò et al., 2013), in primary and lower secondary school. In line with our findings, low IQ has also been reported to be associated with a decreased attainment of school qualifications and post-school educational/vocational qualifications in young adulthood (Fergusson et al., 2005). Thus, previous studies have generally found positive associations between intelligence and educational level (Johnson, Deary, & Iacono, 2009). The association between IQ and number of interruptions to education in young adulthood is consistent with the overall picture of the association between intelligence and unsuccessful educational achievement, but as no previous studies have investigated this association before, future studies need to corroborate this finding.

Consistent with the existing literature is also the finding that low IQ is associated with a higher risk of unemployment in young adulthood. Previous studies have found inverse associations of intelligence with risk of unemployment (Caspi et al., 1998) and duration of unemployment (Fergusson et al., 2005). Furthermore, previous studies have found inverse associations between intelligence and long-term sickness absence (Henderson et al., 2012), duration of welfare benefits receipt (Fergusson et al., 2005), and disability pension (Gravseth et al., 2008; Karnehed et al., 2015; Upmark et al., 2001), as well as positive associations between intelligence and gross income in young adulthood (Fergusson et al., 2005).

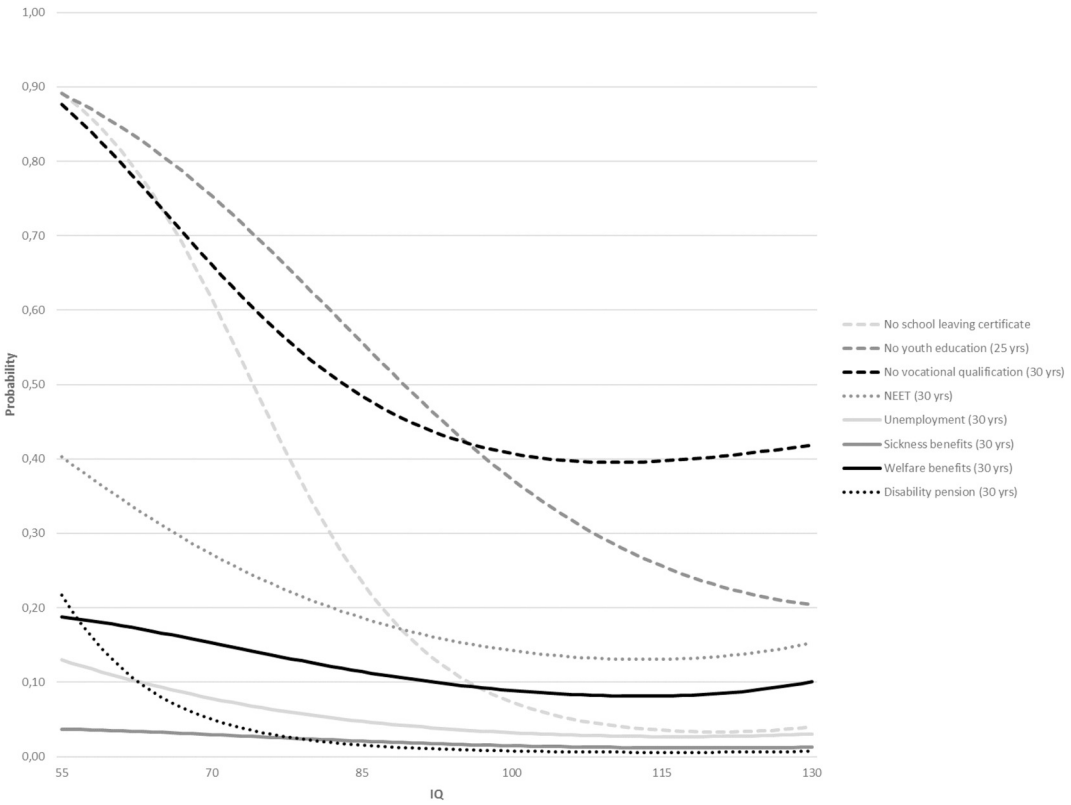

Fig. 1. Probability of unsuccessful educational and occupational achievement according to IQ.
Associations are adjusted for year of birth, ethnicity, birth region, parental education at birth, out-of-home care in childhood, psychiatric diagnoses in childhood, neurological diagnoses in childhood, and perinatal diagnoses and congenital deformities.

Overall, our results show that IQ has the strongest influence on the risk of unsuccessful educational achievement and on the risk of disability pension. Also, it seems that the influence of IQ on educational achievement is strongest in the early educational career and decreases over time, since IQ has the strongest influence on the risk of leaving lower secondary school without a certificate, followed by not having completed a youth education at age 25 and not having completed an education leading to vocational qualifications at age 30. However, in spite of low IQ showing relatively strong associations with unsuccessful educational and occupational achievement, our results suggest no or only weak associations for most of the outcome indicators at superior IQ levels. Nevertheless, among the 12.1% of our study population who left lower secondary school without receiving a certificate, 18.1% had an IQ $<$ 70 and 44.8% had an IQ of 70–89, although individuals with

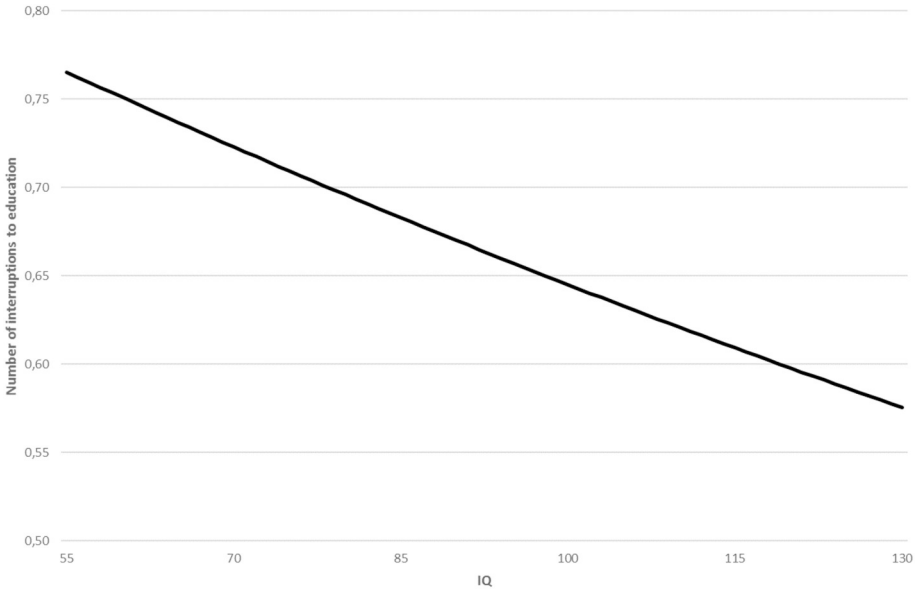

Fig. 2. Number of interruptions to education according to IQ.
Association is adjusted for year of birth, ethnicity, birth region, parental education at birth, out-of-home care in childhood, psychiatric diagnoses in childhood, neurological diagnoses in childhood, and perinatal diagnoses and congenital deformities.

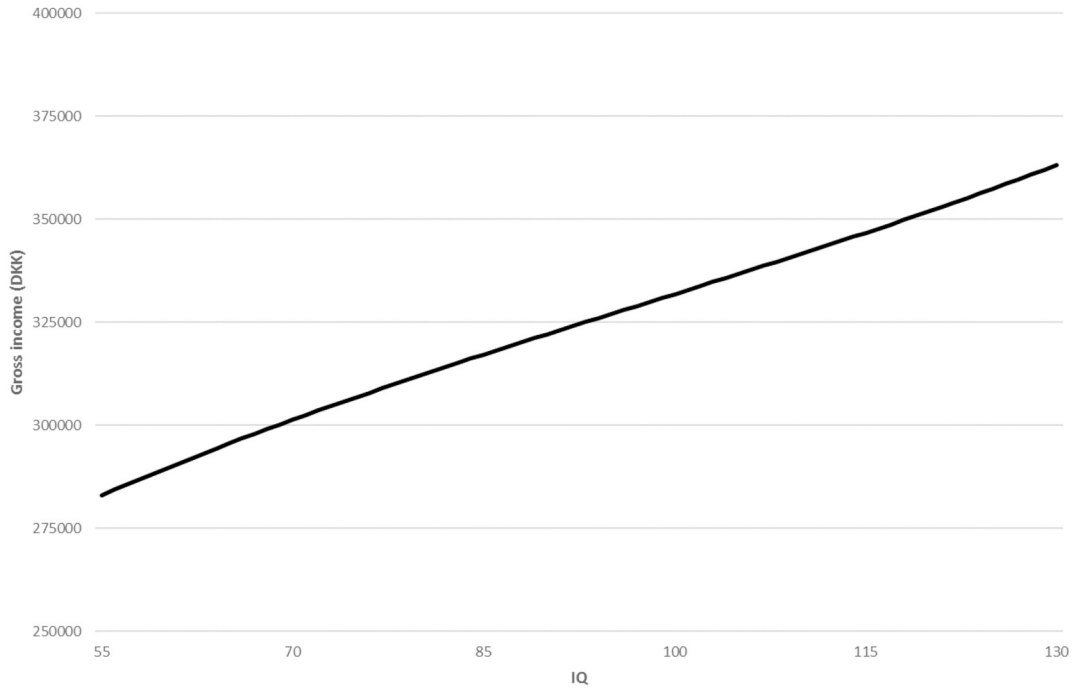

Fig. 3. Gross income according to IQ.
Association is adjusted for year of birth, ethnicity, birth region, parental education at birth, out-of-home care in childhood, psychiatric diagnoses in childhood, neurological diagnoses in childhood, and perinatal diagnoses and congenital deformities.

Table 3
Estimated probabilities of unsuccessful educational & occupational achievement according to IQ score.

	IQ score					
	55	70	85	100	115	130
No school leaving certificate	0.89	0.61	0.23	0.07	0.04	0.04
No youth education at age 25	0.89	0.75	0.56	0.37	0.26	0.20
No vocational qualification at age 30	0.88	0.66	0.48	0.41	0.40	0.42
NEET at age 30	0.40	0.27	0.19	0.14	0.13	0.15
Unemployment at age 30	0.13	0.08	0.05	0.03	0.03	0.03
Sickness benefits at age 30	0.04	0.03	0.02	0.01	0.01	0.01
Welfare benefits at age 30	0.19	0.15	0.11	0.09	0.08	0.10
Disability pension at age 30	0.22	0.05	0.02	0.01	0.01	0.01

Abbreviations: NEET, Not In Employment, Education or Training.

mental retardation and other individuals with low IQ only accounted for 2.9% and 18.7% of the total population, respectively. These findings might indicate that IQ is utmost important in the case of educational achievement in particular in the early educational career, but that non-cognitive factors – such as personality and motivation – play a larger role later in the educational career and in the case of occupational achievement (Schmidt & Hunter, 1998). An exception of this is the influence of IQ on the risk of disability pension, which is much stronger than the other associations between IQ and unsuccessful occupational achievement. This strong association might be due to the extremely strict criteria of being granted a disability pension before the age of 30, which means that disability pension is rarely granted to young adults in Denmark (except, for instance, low-functioning individuals with extremely low IQ).

Unfortunately, our results are not directly comparable with the results of previous studies due to differences in the choice of indicators of unsuccessful educational and occupational achievement, as well as statistical methods and measures of association. Therefore, it is not possible to evaluate whether IQ plays a larger role with regard to unsuccessful educational and occupational achievement in the Danish population compared with countries outside Scandinavia, but our results clearly indicate that IQ is of great importance in Denmark. Future comparative studies should investigate the relative importance of IQ and non-cognitive factors with regard to unsuccessful educational and occupational achievement in countries with a range of different social contexts.

6.3. Strengths and limitations

The major strength of the study is its large study population comprising 1,098,742 young men born since 1950 and appearing before a draft board during the periods 1968–1984 and 1987–2015. Another strength is the use of information from Danish registers due to their high validity and high completeness. The Danish registers' comprehensive data has also made it possible to investigate the role of IQ in predicting a wide range of possible educational and occupational courses among men born across five decades. The use of the BPP as a measure of intelligence can also be considered a strength, since the BPP has been found to have a high correlation with the full-scale Wechsler Adult Intelligence Scale. Finally, the mainly prospective nature of the study reduces the risk of misinterpreting the directions of the observed associations.

However, since the study population's intelligence has been measured at a median age of 19 (range: 17–31) and the indicator of unsuccessful educational achievement – 'no school leaving certificate' – has been measured at an earlier age, we cannot be sure that this association reflects the influence of low IQ on leaving lower secondary school without a certificate. But since previous studies have found that intelligence is relatively stable from childhood until middle age, this is probably not a major concern (Deary, Whalley, Lemmon, Crawford, & Starr, 2000; Deary, Whiteman, Starr, Whalley, & Fox, 2004; Osler, Avlund, & Mortensen, 2013). Nevertheless, what might be a concern is the possible influence of unmeasured confounding. As we do not have information on covariates such as parental mental disorders and parental IQ, these possible confounders were not taken into account. However, much of the influence of these two confounders is probably accounted for by the adjustment for parental socioeconomic position,

but we cannot rule out that unmeasured confounding explains part of the observed associations. Finally, the generalizability of our results to populations who are not liable for military service (such as men with specific medical conditions and females) is not known. However, since several previous studies have found associations between intelligence and unsuccessful educational and occupational achievement in non-conscript populations comprising both men and women, there is no reason to believe that our main findings should not be generalizable to all groups.

7. Conclusions

This study of 1,098,742 Danish men followed in national registers from 1968 to 2016 found that low IQ was a strong and consistent predictor of 10 indicators of unsuccessful educational and occupational achievement in young adulthood. Overall, it seemed that IQ had the strongest influence on the risk of unsuccessful educational achievement and on the risk of disability pension, and that the influence of IQ on educational achievement was strongest in the early educational career and decreased over time. At the community level our findings suggest that intelligence should be considered when planning interventions to reduce the rates of early school leaving and the unemployment rates and at the individual level our findings suggest that assessment of intelligence may provide crucial information for the counselling of poor-functioning schoolchildren and adolescents with regard to both the immediate educational goals and the more distant work-related future.

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Declarations of interest

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