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Citation for published version:

Digital Object Identifier (DOI):
10.1111/ene.15731

Link:
Link to publication record in Edinburgh Research Explorer

Document Version:
Peer reviewed version

Published In:
European Journal of Neurology
Socioeconomic status as a risk factor for Motoric Cognitive Risk syndrome in a community-dwelling population: a longitudinal observational study

Running Title: Motoric Cognitive Risk and socioeconomic status

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Manuscript statistics: Main text of 3352 words, abstract of 258 words, 2 figures, 2 tables, 37 references, and 6 supplementary files

Ethics approval and consent: Ethics permission for the Lothian Birth Cohort 1936 protocol was obtained from the Multi-Centre Research Ethics Committee for Scotland (Wave 1: MREC/01/0/56), the Lothian Research Ethics Committee (Wave 1: LREC/2003/2/29), and the Scotland A Research Ethics Committee (Waves 2-6: 07/MRE00/58). The research was carried out in compliance with the Helsinki Declaration. All participants gave written informed consent for their data to be accessed and used for publication.

Contributions: DSM, GMT, TCR, and ML generated the idea for the present manuscript. DSM obtained and analysed the data, drafted the manuscript, and is the guarantor. All authors edited the manuscript and gave final approval of the version to be published. The corresponding author attests that all listed authors meet authorship criteria and that there has been no omission of others meeting the criteria.

Funding: The present manuscript received no direct funding. DSM is undertaking a PhD Clinical Research Fellowship funded by the Masonic Charitable Foundation and the Royal College of Psychiatrists, United Kingdom. DSM, LES, and TCR are members of the Alzheimer Scotland Dementia Research Centre, which is funded by Alzheimer Scotland. All researchers are independent of their funders. Age UK’s Disconnected Mind project supported data collection for the LBC1936 study, the UK’s Biotechnology and Biological Sciences Research Council (BBSRC) and the Economic and Social Research Council (BB/W008793/1). The Lothian Birth Cohort 1936 study acknowledges the financial support of NHS Research Scotland (NRS) through the Edinburgh Clinical Research Facility.
**Conflicts of interest:** The authors have stated explicitly that there are no conflicts of interest in connection with this article.

**Data availability:** All data is available on reasonable request here: https://www.ed.ac.uk/lothian-birth-cohorts/data-access-collaboration

**Acknowledgements:** The authors are very grateful to the LBC1936 participants, past and present. Their commitment and contributions have made this work and many other important studies possible. Dr Mullin is very grateful for the support of his funders, supervisors, and academic mentors. For the purpose of open access, the authors have applied a CC-BY public copyright licence to any Author Accepted Manuscript version arising from this submission.

**Keywords:** motoric cognitive risk, socioeconomic status, occupation, dementia risk, dementia prediction, slow walking, slow gait, subjective cognitive complaint
Abstract

Background: Motoric Cognitive Risk (MCR) is a syndrome characterised by measured slow gait speed and self-reported cognitive complaints. MCR is a high-risk state for adverse health outcomes in older adults, particularly cognitive impairment and dementia. Previous studies have identified risk factors for MCR, but the effect of socioeconomic status has, to date, been insufficiently examined. This study explores the association between MCR and socioeconomic status, as determined by occupational social class and years of education.

Methods: 690 community-based adults of the Lothian Birth Cohort 1936 (LBC1936), aged 70 years at baseline, were followed up after six years and classified into non-MCR and MCR groups. We applied logistic regression analyses adjusting for demographic, lifestyle, and health covariates to investigate the association between MCR and years of education and occupational social class, categorised into manual vs non-manual occupations.

Results: MCR prevalence at age 76 years was 5.6% (95%CI 4.0-7.6). After multivariate adjustment, participants of lower socioeconomic status (manual occupation) had a greater than threefold increased likelihood of MCR (adjusted odds ratio 3.55, 95%CI 1.46-8.74; p=0.005) compared to those of higher socioeconomic status (non-manual occupation).

Conclusion: Working in a manual job earlier in life triples the risk of MCR later in life, regardless of education. Unravelling this association will likely reveal important pathophysiological mechanisms underlying MCR and may unearth modifiable risk factors which could be targeted to reduce the incidence of MCR and, ultimately, dementia. Policy and healthcare practice addressing dementia risks such as MCR in their social context and early in the lifecourse could be effective strategies for reducing health inequalities in older age.
Introduction

Dementia is a major global public health concern. Much research now focuses on identifying the early predementia stages when intervention may be most effective. Slow gait speed and subjective cognitive complaints are among the earliest reported findings in the pre-clinical stage of dementia, occurring approximately 10 years before dementia diagnosis. Motoric cognitive risk (MCR) is a predementia syndrome defined as objective (measured) slow walking speed and subjective (self-reported) cognitive complaint in the absence of significant functional impairment and dementia. First defined by Verghese in 2013, MCR demonstrates prognostic value as a high-risk state for developing dementia. MCR is a quick, inexpensive, and easy-to-measure clinical construct that can reliably identify individuals at high risk for dementia, but its mechanisms are not yet fully understood. Effective dementia treatments remain elusive. Identifying high-risk individuals would allow for addressing modifiable risk factors and organising future care. It would also assist research trials with cohort recruitment and ultimately contribute to a reduction in the prevalence of dementia. Even a small decrease in dementia prevalence, or delaying the age of onset, would significantly impact the huge associated public health costs.

Having a low socioeconomic status is a powerful predictor of ill health. Early- and mid-life low socioeconomic status has been associated with an increased risk of dementia in later life (adjusted Hazard Ratio [aHR] 1.45; 95% confidence interval [CI] 1.15-1.83), and this difference persists to the oldest-old ages. The 2020 Lancet Commission on dementia highlighted many risk factors that are, at their core, primarily of social origin. Our recent study of MCR showed that socioeconomic status, as defined by occupational social class, was lower for individuals with MCR.
Researchers have operationalised socioeconomic status in various ways, most commonly as education level, social class, income, or occupation. A Swedish study examining the relative importance of these different socioeconomic indicators found that each measure is associated with late-life health, with only minor differences in the effect sizes. However, a 12-year follow-up study in England found that lower wealth in late life, but not education, was associated with increased risk for dementia and that no substantive differences were identified concerning area-based neighbourhood deprivation. Hence, we include both education and occupation class in the present study. By examining the role of socioeconomic status in MCR, we can better understand the mechanisms of MCR. If low socioeconomic status contributes to MCR, people of low socioeconomic status could be supported to reduce their dementia risk. This study explores the longitudinal association between socioeconomic status, as determined by highest education and occupational social class during working age, with MCR later in life (aged 76+ years).

Methods

Setting and sample size

This longitudinal prospective study used baseline socioeconomic status data and six-year follow-up data (wave 3) from the Lothian Birth Cohort 1936 (LBC1936). The LBC1936 has been profiled in detail elsewhere. In summary, between 2004 and 2007, 1091 Scottish adults born in 1936 were recruited for baseline interviews, cognitive tests, questionnaires, blood tests, and physical measures (mean age of 69.5 years [SD=0.8]). There is an almost equal sex split; all participants are white. These participants have been reassessed approximately every three years since. Wave 6 is ongoing at the time of writing, and a seventh is planned. To minimise loss to follow-up between waves, the LBC1936 researchers re-contact those unable to attend a wave due
to a temporary illness and see them at a later, more appropriate time. Figure 1 illustrates sample selection and reasons for dropout and exclusion.

We use data from wave 3, when participants had a mean age of 76.3 years ($n=697$), for our MCR and covariates data, as this is the first and largest wave to measure all the criteria necessary for deriving MCR. We excluded participants with dementia and those missing data in any MCR criteria.

*Insert figure 1 here*

Figure 1: Flow chart of participants

**Outcome Measure - MCR**

We used the original MCR definition of subjective cognitive complaints and objective slow gait in older individuals without significant functional disability or dementia. We defined slow gait using the typical approach for MCR of walking speed one standard deviation (SD) below age- and sex-matched means in this cohort. LBC researchers timed participants with a stopwatch walking six metres along a corridor. A subjective cognitive complaint was recorded if the participant replied affirmatively to the question, “Do you currently have any problems with your memory?”. Loss of independence was determined by scoring over 1.5 SD above the mean on the Townsend Disability Scale (a higher score indicates greater disability). Dementia was assessed by self-report or the Mini-Mental State Examination (MMSE), with a score <24/30 indicating possible dementia.
Socioeconomic status

Our risk factor of interest was socioeconomic status as determined by years of education and the occupational social class of the participants during their working years. This approach for classifying socioeconomic status in LBC1936 has been used many times previously in the literature.\textsuperscript{22–25} Occupational social class is based upon principal occupation, coded in line with the 1980 census and was categorised as professional, managerial, skilled non-manual, skilled manual, or semiskilled/unskilled.\textsuperscript{17,18} As such, it categorises people into a social class grouping rather than giving specific information about the occupation role. Typical for the time, married women were assigned a social class based on the highest occupation of the household, be that their own or their husband’s. Although we could not determine which women were coded based on their husband’s occupation and which were based on their own, it remains typical practice to assign a socioeconomic status to a household based on the highest occupational social group, as opposed to separating a married couple into different social groups.

For our study, we collapsed the occupational classes of professional, managerial, and skilled non-manual into a ‘non-manual’ category and the skilled manual and semiskilled/unskilled classes into a ‘manual’ category. This preserved the distinction between higher and lower socioeconomic status while improving the data distribution and providing a relevant comparator for a measure like MCR, which contains a motor/manual component such as gait speed. Supplementary Table 1 presents the descriptive characteristics of the non-manual and manual occupation groups for comparison. The non-manual and manual occupation groups differed significantly in several key characteristics, including age, sex, years of education, smoking status, depression symptoms, and grip strength (Supplementary Table 1). BMI is also significantly different between manual (29.1 ± 4.6 kg/m\(^2\)) and non-manual (27.4 ± 4.4 kg/m\(^2\)) occupational social classes, but dietary pattern is not available to explore this further. Our final model adjusts for all these potential
confounders. Age 11 intelligence also differs significantly between non-manual and manual groups, but as expected, age 11 intelligence and occupational social class were collinear, so it was not included in our model.

Other risk factors

Based primarily on reported risk factors for MCR, we included the following risk factors in our analysis: age, sex, self-reported smoking status (current/ex/never), body mass index (BMI), depression and anxiety symptoms (Hospital Anxiety and Depression Scale), and grip strength (combined average of left and right). The presence of self-reported stroke, hypertension, cardiovascular disease, diabetes, Parkinson’s disease, arthritis, leg pain, or neoplasia was used to calculate a summary multimorbidity index (scored 0 to 8). Self-reported physical activity levels are: 1 = moving only in connection with necessary household chores; 2 = walking or other outdoor activities 1-2 times per week; 3 = walking or other outdoor activities several times per week; 4 = exercising 1-2 times per week to the point of perspiring and heavy breathing; 5 = exercising several times per week to the point of perspiring and heavy breathing; 6 = keep-fit/heavy exercise or competitive sport several times per week.

Statistical Methods

We summarised the participants’ characteristics using means and SD or frequencies and percentages, as appropriate. We compared non-MCR and MCR groups using $\chi^2$ tests with a continuity correction for categorical variables. We performed an F-test (ANOVA) by default for continuous explanatory variables. We used a Kruskal-Wallis test when variables were considered non-parametric, except when expected counts were less than five, where Fisher’s exact test was more appropriate.
We estimated the odds ratio (OR) association with 95% CIs of socioeconomic status, as determined by occupational social class and years of education, with MCR using logistic regression models. The basic model (Model 1) adjusted for age and sex. Model 2 adjusted for all covariates in Model 1 plus lifestyle variables. Model 3 adjusted for all covariates in Model 2 plus health variables. Our final model, Model 4, adjusted for all covariates in Model 3 plus mental and physical measures. Final model selection was performed using a criterion-based approach, whereby we minimised the Akaike information criterion (goodness-of-fit test), maximised the C-statistic (model discrimination) and ensured a non-significant Hosmer-Lemeshow test (calibration of model prediction ability). We performed a sensitivity analysis with the sexes separated. We assessed for possible bias due to missing data by comparing the distribution of missingness in the final model variables amongst MCR and non-MCR groups. The main analysis was based on participants with no missing data. We performed variance inflation factor analysis to ensure no multicollinearity between variables in the final regression model. We considered p-values of <0.05 statistically significant. All statistical analyses were conducted in R version 4.0.2, using the “finalfit” package version 1.0.4.27,28 Code is openly shared on Github.29 LBC1936 data are available on request from the LBC1936 team (https://www.ed.ac.uk/lothian-birth-cohorts/data-access-collaboration).30 The reporting of this study conforms to the STROBE statement.31

Results

1091 participants were initially recruited at baseline (49.8% female, mean [SD] age 69.5 [0.8] years). The variables necessary to derive MCR were first measured at the six-year follow-up time point (wave 3), which had 697 participants. One participant was excluded as they had been diagnosed with dementia before wave 3. A final total of 696 participants (48.0% female, mean
[SD] age 76.3 [0.7] years) were included in our study sample, giving a participation rate of eligible persons of 99% (63% of baseline participants). Nine participants were missing data in the occupational social class variable, and four were missing data necessary for MCR determination. Our final model included 671 participants. The main reasons for loss to follow-up in the LBC1936 are death, chronic incapacity, and permanent withdrawal. Figure 1 illustrates the participant flow in this study.

Table 1 presents the characteristics of the study participants, comparing the MCR and non-MCR groups. Despite the narrow age range, the MCR group is significantly older. Aside from the differences between MCR and non-MCR groups for occupational social class, there are no other significant differences in any demographic, lifestyle, medical history, or physical or mental measures.

Insert Table 1: Characteristics of study participants

Main Results

MCR prevalence at wave 3 was 5.6% (95% CI 4.0 to 7.6; n=39/696). Table 2 presents the results of the final logistic regression analysis model. The final and most adjusted model (Model 4) demonstrates that working in a manual rather than a non-manual occupation earlier in life is associated with a greater than threefold increased risk of having MCR later in life (aOR 3.55, 95% CI 1.46 to 8.74; p=0.005). This is illustrated in Figure 2, with full detail in Table 2.

Insert Figure 2: Odds ratio plot showing the association of Motoric Cognitive Risk (dependent variable) with occupational social class, adjusted for potential confounders
Supplementary Table 2 details further information on earlier models and model building. The model building shows that knowing a participant’s occupational social class, education, age and sex alone (Model 1) would provide a 71% chance of predicting correctly whether this participant will develop MCR later in life (C-statistic 0.71) but that adjusting for demographic, lifestyle, and health factors (Model 4) improves this to a 75% chance (C-statistic 0.75).

Insert Table 2: Final model - logistic regression of Motoric Cognitive Risk (dependent variable) and occupational social class, with and without adjustment for potential confounders.

None of the main explanatory variables are collinear, as illustrated in Supplementary Figure 1. Variance factor analysis suggests no evidence of multicollinearity among any of the variables in our final model (Supplementary Table 3).

Sensitivity analysis

We performed a sensitivity analysis with the sexes separated to explore their effect on the true association between socioeconomic status and MCR. We used the same analysis approach and factors as our main analysis, except we excluded the sex variable. In the male cohort (Supplementary Table 4), the effect of manual occupational social class on future MCR risk was higher than in the overall cohort when unadjusted (OR 3.79 [1.48-10.45, p=0.007]) but the same when adjusted (aOR 3.55 [1.19-11.73, p=0.028]). In the female cohort, only three female participants had both MCR and a manual occupation, which was too small for further analysis.

As so few participants had MCR data missing (n = 4), we have not included here our sensitivity analysis on those with missing data for MCR derivation. However, for completeness, this information is in Supplementary Table 5.
Discussion

Our main finding is that lower socioeconomic status as defined by non-manual vs manual occupation (and not years of education) is associated with a more than threefold increased risk of having MCR later in life (aOR 3.55, 95% CI 1.46 to 8.74; p=0.005). The strong association between manual occupation and increased risk of MCR remained despite adjusting for an extensive array of potential confounds. This is the first study to focus on socioeconomic status as a risk factor for MCR, which adds to its value and importance but makes it difficult to place it in context. However, a recent study examining manual and non-manual occupational social class found that manual occupation is associated with dementia-related death. As MCR is highly prognostic of dementia in later life, our main finding has good face validity.

Occupational social class

The LBC1936 dataset contains another measure of socioeconomic status, the Scottish Index of Multiple Deprivation (SIMD). This is a relative measure of deprivation across small areas of Scotland, ranked 1 (most deprived) to 6976 (least deprived). As this is a population-level measurement, people living in the same area but with very different jobs and socioeconomic circumstances will have the same SIMD rank. As such, it is less informative on an individual level than occupational social class or years of education, and we did not include it in our model.

Income data is unavailable for the participants. However, working-age occupation class is a good proxy measure for individual wealth later in life, often better than other indices such as neighbourhood deprivation or years of education. As such, it is likely that the difference in health outcomes between these two groups is partly mediated by economic status.
Other covariates

Despite the narrow age range of LBC1936 participants, we noted a significant association between older age with the presence of MCR. This is in keeping with a recent meta-analysis of factors associated with MCR in 22 studies, which found that a majority reported age as an associated factor for the presence of MCR. There was no significant relationship between MCR status and any other variables tested for, including those traditionally associated with MCR such as obesity, multimorbidity, depression, and anxiety. This is surprising as we chose these variables a priori based primarily on their previous association with MCR. Our study may not have the power to detect a significant relationship, an idea supported by the effect sizes of these other variables, which are generally in the same direction as larger studies. Further investigation is required using case-control studies or much larger cohort studies.

The lack of association between MCR and traditional risk factors for MCR may also be partly due to healthy volunteer bias. Lothian is a relatively affluent area of Scotland, and the participants in LBC1936 have a higher average number of years of education and better general physical fitness than the Scottish population. Participants are also all white. These factors should be considered when generalising these findings to other populations. However, the overall affluence of the LBC1936 sample may underplay the role of socioeconomic status as a risk factor for MCR. Perhaps a more socioeconomically diverse cohort would reveal an even stronger association effect size between low and high socioeconomic status and MCR. This would be an important future study in a more population-representative cohort.

Perceived stress and levels of social support may mediate the association between occupation and MCR. Unfortunately, specific data on these variables were not available. However, the participants in LBC1936 retired long before wave 3 (mean age 76 years) when we first derived MCR. As such, any questionnaires regarding occupational stress would rely on recall from many
years before. Nevertheless, while not stress-specific, we included depression and anxiety symptoms (Hospital Anxiety and Depression Scale) in our final adjusted model even though there were no significant differences in symptoms between MCR and non-MCR groups. This was an a priori decision based on previously reported associations between these psychological symptoms and MCR in the literature.9,26,33

**Limitations and strengths**

Our data had additional limitations to those already discussed. Growing research identifies head trauma as a risk factor for later-life subjective and objective cognitive impairment.34 A potential increased rate of head trauma related to occupation could mediate the relationship between socioeconomic status and MCR, but these data are unavailable in our cohort. Attrition from ill-health or mortality is a common and often unavoidable limitation of longitudinal studies of ageing. The LBC1936 research team attempt to minimise attrition by re-contacting those unable to attend a wave due to a temporary illness and assessing them at a later, more appropriate time where possible. Despite this, attrition in the LBC1936 is approximately 20% between waves, leading to a 37% loss of participants over the six years between baseline and wave 3. Although this attrition is substantial, it is within the limit of what is considered acceptable by international quality assessment bodies.35 Fortunately, our study has an excellent participation rate (99%) of the eligible sample, with only seven of the 697 available participants excluded, which helps address any selection bias. Despite this, our sample size is still small and a replication study in a larger cohort, or a cohort with a higher prevalence of MCR, would increase confidence in our findings. A replication study is certainly feasible. MCR has been derived in many cohorts globally.7 Likewise, socioeconomic status has been operationalised in various ways,15 all of which are associated with late-life health, with only minor differences in the effect sizes.15
Implications

An association between lower socioeconomic status and MCR has several implications. First, the mechanism of this association must be clarified. Because we had insufficient women with MCR in the sample, we could not separate the effects of occupation \textit{per se} from the effects of factors related to occupation. A significant association in women who did not work but shared the SES of their husband would suggest the importance of occupation-related factors, such as household income. Alternatively, individuals in higher occupational classes often have jobs that require higher levels of intellectual function;\textsuperscript{36} perhaps having a more cognitively demanding job offers protection against developing MCR later in life. Second, if this association were to reflect a causal link between socioeconomic status and MCR, policy measures which target socioeconomic inequality in early- and mid-life might reduce the number of individuals transitioning to the high-risk state of MCR and then to dementia. This is supported by a 2017 study assessing the contribution of socioeconomic status at three life-course periods to memory function in later life. The authors reported that upward mobility in mid- and late-life somewhat offset the effects of low socioeconomic status earlier in life.\textsuperscript{37} Finally, public health strategies should target people with lower socioeconomic status for earlier dementia detection and intervention. Given that approximately 50 million people worldwide live with dementia, a number projected to triple over the next 30 years,\textsuperscript{13} even a small reduction in incidence or delaying the age of onset could make a substantial difference to patients, families and societies globally.

Conclusion

In conclusion, this prospective study shows an association between lower socioeconomic status, as defined by manual occupation at a younger age, and MCR at an older age, but no effect of educational attainment. This relationship remained after adjustment for demographics, lifestyle factors, and health measures. Unravelling this association will likely reveal important
pathophysiological mechanisms underlying MCR and may unearth modifiable risk factors which could be targeted to reduce the incidence of MCR and, ultimately, dementia. Policy and healthcare practice addressing dementia risks such as MCR in their social context and early in the life course could be effective strategies for reducing health inequalities in older age.
References


Table and Figure Captions

Figure 1 Flow chart of participants

Note - SD: Standard Deviation; MCR: Motoric Cognitive Risk; HADS-D: Hospital Anxiety and Depression Status – Depression; HADS-A: Hospital Anxiety and Depression Status – Anxiety; BMI: Basal Metabolic Rate
Figure 2: Odds ratio plot showing the association of Motoric Cognitive Risk (dependent variable) with occupational social class, adjusted for potential confounders.

Note - MCR: Motoric Cognitive Risk; OR: odds ratio; CI: Confidence Interval; HADS-A: Hospital Anxiety and Depression Status – Anxiety; HADS-D: Hospital Anxiety and Depression Status – Depression; Multimorbidity index: the presence of self-reported stroke, hypertension, cardiovascular disease, diabetes, Parkinson’s disease, arthritis, leg pain, or neoplasia was used to calculate a summary multimorbidity index (scored 0 to 8); BMI: Basal Metabolic Rate, kg/m²: kilograms per metre squared.
Table 1: Covariate descriptive statistics for participants with and without Motoric Cognitive Risk.

* p-value <0.05; MCR: Motoric Cognitive Risk; SD: Standard Deviation; HADS-A: Hospital Anxiety and Depression Status – Anxiety; HADS-D: Hospital Anxiety and Depression Status – Depression; Multimorbidity index: the presence of self-reported stroke, hypertension, cardiovascular disease, diabetes, Parkinson’s disease, arthritis, leg pain, or neoplasia was used to calculate a summary multimorbidity index (scored 0 to 8); BMI: Basal Metabolic Rate; kg/m²: kilograms per metre squared; kg: kilograms.
Table 2: Final model - logistic regression of Motoric Cognitive Risk (dependent variable) and socioeconomic status at baseline with and without adjustment for potential confounders.

Number in dataframe = 694, Number in model = 673, Missing = 21, AIC = 297.3, C-statistic = 0.716, H&L = Chi-sq(8) 6.28 (p=0.616)

* p-value <0.05; MCR: Motoric Cognitive Risk; SD: Standard Deviation; HADS-A: Hospital Anxiety and Depression Status – Anxiety; HADS-D: Hospital Anxiety and Depression Status – Depression; Multimorbidity index: the presence of self-reported stroke, hypertension, cardiovascular disease, diabetes, Parkinson’s disease, arthritis, leg pain, or neoplasia was used to calculate a summary multimorbidity index (scored 0 to 8); BMI: Basal Metabolic Rate; kg/m²: kilograms per metre squared; kg: kilograms; AIC: Akaike Information Criterion; H&L: Hosmer-Lemeshow test.
Table 1: Covariate descriptive statistics for participants with and without Motoric Cognitive Risk.

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</tbody>
</table>

* p-value <0.05; MCR: Motoric Cognitive Risk; SD: Standard Deviation; HADS-A: Hospital Anxiety and Depression Status – Anxiety; HADS-D: Hospital Anxiety and Depression Status – Depression; Multimorbidity index: the presence of self-reported stroke, hypertension, cardiovascular disease, diabetes, Parkinson’s disease, arthritis, leg pain, or neoplasia was used to calculate a summary multimorbidity index (scored 0 to 8); BMI: Basal Metabolic Rate; kg/m²: kilograms per metre squared; kg: kilograms.
Table 2: Final model - logistic regression of Motoric Cognitive Risk (dependent variable) and occupational social class, with and without adjustment for potential confounders.

<table>
<thead>
<tr>
<th></th>
<th>MCR</th>
<th>No MCR</th>
<th>OR (univariable)</th>
<th>aOR (multivariable)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Occupational class</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual</td>
<td>15</td>
<td>122</td>
<td>2.80 (1.39-5.47, p=0.003)</td>
<td>3.55 (1.46-8.74, p=0.005)</td>
</tr>
<tr>
<td>Non-manual</td>
<td>23</td>
<td>523</td>
<td>0.43 (0.25-0.71, p=0.001)</td>
<td>0.44 (0.24-0.76, p=0.004)</td>
</tr>
<tr>
<td><strong>Education, years</strong></td>
<td>Mean (SD)</td>
<td>10.6 (1.1)</td>
<td>2.80 (1.39-5.47, p=0.003)</td>
<td>3.55 (1.46-8.74, p=0.005)</td>
</tr>
<tr>
<td><strong>Age, years</strong></td>
<td>Mean (SD)</td>
<td>76.6 (6.6)</td>
<td>0.43 (0.25-0.71, p=0.001)</td>
<td>0.44 (0.24-0.76, p=0.004)</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>20</td>
<td>313</td>
<td>1.14 (0.60-2.20, p=0.684)</td>
<td>1.38 (0.47-4.21, p=0.560)</td>
</tr>
<tr>
<td>Male</td>
<td>19</td>
<td>340</td>
<td>2.19 (0.59-6.56, p=0.188)</td>
<td>1.53 (0.36-5.34, p=0.529)</td>
</tr>
<tr>
<td><strong>Smoking history</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>4</td>
<td>39</td>
<td>1.42 (1.05-1.95, p=0.025)</td>
<td>1.30 (0.93-1.88, p=0.140)</td>
</tr>
<tr>
<td>Ex-smoker</td>
<td>13</td>
<td>278</td>
<td>1.76 (0.93-3.33, p=0.064)</td>
<td>1.53 (0.36-5.34, p=0.529)</td>
</tr>
<tr>
<td>Never</td>
<td>22</td>
<td>335</td>
<td>1.01 (0.91-1.13, p=0.856)</td>
<td>1.05 (0.93-1.21, p=0.428)</td>
</tr>
<tr>
<td><strong>Physical activity level</strong></td>
<td>Mean (SD)</td>
<td>2.4 (1.1)</td>
<td>1.42 (1.05-1.95, p=0.025)</td>
<td>1.30 (0.93-1.88, p=0.140)</td>
</tr>
<tr>
<td>Anxiety, HADS-A</td>
<td>Mean (SD)</td>
<td>4.6 (3.1)</td>
<td>1.01 (0.91-1.13, p=0.856)</td>
<td>1.05 (0.93-1.21, p=0.428)</td>
</tr>
<tr>
<td>Depression, HADS-D</td>
<td>Mean (SD)</td>
<td>3.2 (2.3)</td>
<td>0.95 (0.83-1.09, p=0.414)</td>
<td>1.00 (0.85-1.19, p=0.999)</td>
</tr>
<tr>
<td>Multimorbidity index</td>
<td>Mean (SD)</td>
<td>2.4 (1.3)</td>
<td>0.92 (0.73-1.17, p=0.485)</td>
<td>1.00 (0.76-1.32, p=0.995)</td>
</tr>
<tr>
<td>BMI, kg/m^2</td>
<td>Mean (SD)</td>
<td>28.4 (4.2)</td>
<td>0.96 (0.90-1.03, p=0.292)</td>
<td>0.99 (0.92-1.07, p=0.810)</td>
</tr>
<tr>
<td>Grip strength, kg</td>
<td>Mean (SD)</td>
<td>25.4 (10.3)</td>
<td>1.02 (0.99-1.06, p=0.242)</td>
<td>1.01 (0.96-1.07, p=0.645)</td>
</tr>
</tbody>
</table>

Number in dataframe = 696, Number in model = 671, Missing = 25, AIC = 291.5, C-statistic = 0.748, H&L = Chi-sq(8) 11.07 (p=0.198)

MCR: Motoric Cognitive Risk; OR (Odds Ratio); aOR (adjusted Odds Ratio); SD: Standard Deviation; Physical activity level: self-reported (1 to 6, higher indicating more physical activity); Multimorbidity index: the presence of self-reported stroke, hypertension, cardiovascular disease, diabetes, Parkinson’s disease, arthritis, leg pain, or neoplasia was used to calculate a summary multimorbidity index (scored 0 to 8); BMI: Basal Metabolic Rate; HADS-A: Hospital Anxiety and Depression Status – Anxiety; HADS-D: Hospital Anxiety and Depression Status – Depression; kg/m^2: kilograms per metre squared; kg: kilograms; AIC: Akaike Information Criterion; H&L: Hosmer-Lemeshow test.
**Wave 1 (Baseline)**

- $n = 1091$
- Mean age (SD) = 69.5 (0.8)

Wave 2

- $n = 866$
- Mean age (SD) = 72.5 (0.7)

**Wave 3 (MCR derived)**

- $n = 696$
- Mean age (SD) = 76.3 (0.7)

Final Model

- $n = 671$

225 participants lost (20.6% of baseline)
- 39 died
- 151 withdrew
- 13 not well enough / no longer eligible
- 19 lost contact
- 3 other reasons

169 participants lost (19.5% of Wave 2)
- 38 died
- 96 withdrew
- 18 not well enough / no longer eligible
- 8 lost contact
- 9 other reasons
- 1 diagnosed with dementia

21 participants missing one or more model variables (3.3% of wave 3 sample)
- 9 Socioeconomic status data missing
- 8 Grip strength data missing
- 4 missing data in any MCR criterion
- 3 BMI data missing
- 1 HADS-D data missing
- 1 HADS-A data missing
- 1 Smoking missing

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Figure 1 Flow chart of participants

SD: Standard Deviation; MCR: Motoric Cognitive Risk; HADS-D: Hospital Anxiety and Depression Status – Depression; HADS-A: Hospital Anxiety and Depression Status – Anxiety; BMI: Basal Metabolic Rate
Figure 2: Odds ratio plot of the final logistic regression model of baseline socioeconomic status associated with MCR adjusted for potential confounders at wave 3 (six-year follow-up).

Note - MCR: Motoric Cognitive Risk; OR: odds ratio; CI: Confidence Interval; HADS-A: Hospital Anxiety and Depression Status – Anxiety; HADS-D: Hospital Anxiety and Depression Status – Depression; CVD: Cardiovascular; BMI: Basal Metabolic Rate, kg/m²: kilograms per metre squared. Age, years = younger age.