

Supplemental Digital Content 1

Imputation of grade point average values

A standard grading system is used in Finland, but not all schools give numerical grades during the first comprehensive school years. In the present sample, teachers of 1,249 twin participants at age 12 reported that numerical grades were not given. For these participants we imputed their most likely grade point average category based on several school performance measures reported by the teachers, as was done in earlier studies^{1,2}. We used a total of seven academic and behavioural measures (i.e., spelling, writing essays, reading aloud, comprehension, mathematics, diligence, and attentiveness), reported by the teachers, as predictors of the ordinal grade point average variable in a multinomial logistic regression model. Correlations between these measures and grade point average were between 0.59 and 0.69. Based on the pseudo-R² statistic, the measures collectively explained 44% of the variation in the grade point average variable in the multinomial logistic model.

We used the post-estimation command with the outcome option in Stata 12 (StataCorp, College Station, Texas)³ to estimate the probability of each category and then selected the most likely category for each individual with a missing grade point average value. Of the 1,249 twin participants, 616 participants (49.3%) were imputed as having a grade point average from better than 8 to 9, 568 participants (45.5%) as having a grade point average from better than 7 to 8, and 65 participants (5.2%) as having a grade point average from better than 6 to 7. These proportions were in line with the grade point average distribution in the full sample where the corresponding proportions were 46.5%, 40.0% and 8.3%, respectively. The predicted probabilities of belonging to these categories ranged from 0.83 to 0.93.

To check for any potential bias introduced by the imputation, we compared the correlations of the original (non-imputed) and the final (imputed and non-imputed) grade point average variables with leisure-time physical activity measures at age 12. The correlations were similar (0.03 and 0.04, respectively), suggesting that no bias was present.

References

1. Latvala, A., et al. Drinking, smoking, and educational achievement: cross-lagged associations from adolescence to adulthood. *Drug Alcohol Depend.* 137, 106–113 (2014).
2. Aaltonen S, Latvala A, Rose RJ, Kujala UM, Kaprio J, Silventoinen K. Leisure-time physical activity and academic performance: cross-lagged associations from adolescence to young adulthood. *Sci Rep.* 2016;15;6:39215.
3. StataCorp. Stata Statistical Software: Release 12. (StataCorp LP, 2011).