

THE ASSOCIATION BETWEEN SCHOOL PERFORMANCE AT 14 YEARS AND YOUNG ADULTS' USE OF CANNABIS: AN AUSTRALIAN BIRTH COHORT STUDY

Mohammad R Hayatbakhsh, Michael J O'Callaghan, Konrad Jamrozik, Jake M Najman, et al.

Abstract (Summary)

This study examines, firstly, the association between school performance at 14 years and frequency of use of cannabis in early adulthood and, secondly, whether this association is explained by family and individual characteristics, including child cognitive capacity in childhood and adolescence. Data are from a cohort of 3,478 Australian young adults who were followed up from birth to age 21 years. Data on child school performance and use of cannabis were collected at the 14- and 21-year follow-ups, respectively. Child school performance was assessed at 14 years via self- and maternal-report. Potential confounding factors were measured between the child's birth and age 14 years. School performance at 14 years predicts young adults' use of cannabis. Children who had lower school performance had increased risk of frequent use of cannabis in young adulthood. Exploration of the pathway linking school performance and cannabis use in young people may help identify opportunities for preventive interventions. [PUBLICATION ABSTRACT]

[Headnote]

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INTRODUCTION

Cannabis is the most commonly used illicit drug around the world and in Australia (Hall & Pacula, 2003). Use usually begins in adolescence (Chen & Kandel, 1995). In Australia, three in five persons aged 20 to 29 years have used cannabis in their lifetime (Australian Institute of Health and Welfare, 2005) and one third of cannabis users meet the criteria for ever experiencing cannabis abuse or dependence (Swift, Hall, & Teesson, 2001). Moreover, frequent use of cannabis in adolescence and early adulthood incrementally increases the risk of abuse/dependence of other illicit drugs (Agrawal, Neale, Prescott, & Kendler, 2003) and mental health problems (Hayatbakhsh et al., 2007). Identifying predictors of cannabis use may be important in developing appropriate prevention strategies. A variety of environmental and individual factors are related to the development of cannabis problems in adolescents and young adults (see review by Hawkins, Catalane, & Miller, 1992).

Of these factors, the relationship between child school performance (CSP) and later use of cannabis remains uncertain. Several cross-sectional and retrospective studies have found an association between cannabis use and educational attainment as well as school performance among school children and youth (Fergusson, Lynskey, & Horwood, 1995; Lynskey, White, Hill, Letcher, & Hall, 1999; Mensch & Kandel, 1988; Novins & Mitchell, 1998). These studies suggest that use of cannabis in adolescence and early adulthood increases the risk of poor educational performance and dropout

from school. However, the results of cross-sectional or retrospective studies cannot resolve the direction of the association. It may be that use of cannabis undermines school performance, or that poor educational performance leads to cannabis use, or both may be a reflection of other factors.

A number of prospective investigations have shown that early use of cannabis is associated with poor school academic performance and early cessation of schooling (Fergusson, Horwood, & Beautrais, 2003; Fergusson, Lynskey, & Horwood, 1996; Lynskey, Coffey, Degenhardt, Carlin, & Patton, 2003; Newcomb & Bentler, 1986). Fergusson and colleagues (1996), using data from a birth cohort study, found that after controlling for confounding covariates, adolescents who had used cannabis by the age of 15 years were twice as likely to have poorer educational achievements at the age of 16 years. Subsequent follow-up of the same cohort showed that frequent use of cannabis during the interval between 15 and 25 years predicted young adults' stopping formal education without achieving a qualification (Fergusson et al., 2003). Similar findings have been reported in two other longitudinal studies (Brook, Balka, & Whiteman, 1999; Ellickson, Bui, Bell, & McGuigan, 1998).

Less attention has been devoted to the possible reverse association, namely, that CSP and academic attainment might influence later use of cannabis (Poikolainen et al., 2001; Schulenberg, Bachman, O'Malley, & Johnston, 1994). Using a four year follow-up of 3,399 high school students in the United States, Schulenberg and colleagues (1994) examined the association between high school students' grade point average and their use of licit and illicit drug in early adulthood. They found that higher school performance was associated with decrease in use of illicit drugs four years later. However, in another study, Poikolainen et al. (2001) did not indicate a significant relationship between students' grade point average in 9th grade and initiation to cannabis use by the time they were young adults. The discrepancy in the results of these studies might be due to different measurement of outcome, inclusion of confounding variables, and method of analyses.

Several mechanisms may explain the association between CSP and substance use. One hypothesis is that the two phenomena have a common or shared pathway. In this case, the link between CSP and substance use might be due to other factors (confounders), rather than causal. For example, school failure is associated with family backgrounds such as socio-economic status and marital disruption (Natriello, McDill, & Pallas, 1990). In addition, children with a high level of problem behaviors are more prone to drop out of school and to have poor educational attainment (Moffitt & Silva, 1987). These family and individual factors are also associated with the later use of substances by children (Hawkins et al., 1992; Hayatbakhsh, Najman, Jamrozik, Mamun, & Alati, 2006; King, Iacono, & McGue, 2004). Furthermore, cognitive capacity as measured by IQ is associated with the use of cannabis (Solowij et al., 2002). This means that there is a need to consider possible impact of these potential confounders when investigating the association between CSP and cannabis use.

A second hypothesis is that poor CSP increases the probability of later illicit drug use, either directly or indirectly. For example, it is possible that poor academic achievement increases the child's school dropout and precedes employment difficulties in late adolescence and early adulthood, and as proposed by Merton (1957), these individuals may turn to deviant means, such as use of substances, in order to compensate for an inability to achieve socially desirable goals.

Overall, there is limited evidence showing that CSP can predict risk of young adults' use of illicit drugs, as previous studies have failed to control adequately for potential individual and environmental factors that may confound the association (Poikolainen et al., 2001 ; Schulenberg et al., 1994). Using a prospective birth cohort, this study examined (a) whether CSP at 14 years predicts later use of cannabis and presence of cannabis use disorders by early adulthood, (b) whether this association is independent of the possible influences of family and individual background and

cognitive ability, and (c) whether dropout from school and employment status mediate the link between CSP and use of cannabis.

METHOD

DATA

Data were taken from the Mater University of Queensland study of pregnancy (MUSP). As described in detail elsewhere (Najman et al., 2005), MUSP is a birth cohort study of women who were enrolled at the Mater Misericordiae Hospital in Brisbane, Australia, between 1981 and 1983. Baseline data were collected at the first antenatal visit from 7,223 consecutive women who gave birth to a live singleton baby and who were followed up on three to five days, six months, five, 14, and 21 years after birth. Informed consent from the mother was obtained at all phases of data collection and from the young adult at the 21-year follow-up. Ethics committees from the Mater Hospital and the University of Queensland approved each phase of the study. The present analyses are based on 3,478 young adults who completed the 21-year questionnaire and for whom data were available about school performance at 14 years. Previous studies have shown that lost to follow-up in MUSP was related to child's gender, family income, mother's education, maternal marital status, maternal substance use, adolescent problem behaviors, and adolescent smoking at 14 years (Hayatbakhsh et al., 2006; Mamun, Lawlor, O'Callaghan, Williams, & Najman, 2005). In the current study, loss to follow-up was predicted by gender, family income, maternal marital structure, maternal tobacco use at 14 years, and child school performance and externalizing behavior at 14 years.

MEASURES

YOUNG ADULTS' CANNABIS USE AND USE DISORDERS

Consumption of cannabis was assessed at the 21-year follow-up via a self-report questionnaire in which participants were asked, "In the last month how often did you use cannabis, marijuana, pot, etc.?" Options for response included: have never used, once or so, not in the last month, every few days, and used every day. Based on the frequency of use reported at the 21-year follow-up, ever users of cannabis were divided into two categories: occasional use and frequent use, referring to use of cannabis once in last month or not in the last month, and every day or every few days, respectively.

At the 21-year phase of the study, we used the computerized version of Composite International Diagnostic Interview (CIDI-Auto) (World Health Organization [WHO], 1997) to assess a lifetime diagnosis of both cannabis abuse and dependence, according to DSM-IV diagnostic criteria (American Psychiatric Association [APA], 1994). Individuals who, at age 21, met the DSM-IV criteria for lifetime cannabis dependence or abuse were categorized as having had cannabis use disorders. We also assessed abuse or dependence relating to other illicit drugs including heroin, amphetamines, ecstasy, cocaine, hallucinogens, inhalants, and others. Participants who reported having symptoms of abuse or dependence for other illicit drugs were classified as having other illicit drug use disorders. Due to limited financial resources, only a subsample of 2,407 young adults were administered the lifetime version of CIDI-Auto. Demographic characteristics of this subsample were similar to those who completed the self-report questionnaire.

CHILD SCHOOL PERFORMANCE

CSP was assessed at the 14-year follow-up via maternal and child's self-report. Children were asked to describe their school performance in English, mathematics, and science. Options for each

question were 1 - below average, 2- a bit below average, 3- average, 4- a bit above average, and 5- above average. The three items had internal consistency (Cronbach's alpha = 0.71) and mean inter-item correlation = 0.45. Using the individual's mean score for these three questions we divided the subjects into three groups: high (4 or higher), moderate (2.1 - 3.9), and low performance (2 or lower). A separate question asked, "how are you doing at school overall?" with option being 1 - below average and 2- a bit below average (collectively categorized as low), 3- average (denoted average later), 4- a bit above average, and 5- above average (collectively categorized as high). At the 14-year follow-up, mothers were similarly asked to describe their children's overall school performance. There was a good correlation between our computed average (based on English, math, and science) and self-report of overall school performance (Spearman correlation = 0.60, $p < 0.001$) and a moderate correlation between self-report average and maternal report of overall school performance (Spearman correlation = 0.48, $p < 0.001$).

It could be argued that the questions used in this research provide a subjective perception of school performance, not actual school performance, as the students and their mothers' reports of school performance are likely to be subject to over reporting. We conducted a statistical test to examine the validity of our self-reported school performance. At the 21-year follow-up, 1,708 young adults indicated their high school overall position (OP) score in grade 12 (age 16 to 17 years) (between 1, highest and 25 lowest). There was a substantially significant and moderately strong correlation between self-reported school performance at 14 years and OP score at age 16 to 17 years (Pearson correlation = 0.48, $p = 0.001$).

OTHER COVARIATES

Maternal socio-demographic variables included maternal age (below 20 and 20 years or older) and education (did not complete high school, completed high school, and post high school education) assessed when the child was born, and gross family income at the five-year follow-up (selecting the 25th percentile as the cutoff below which family income was defined as low).

Maternal marital status was self-reported by mothers at the 14-year follow-up as being unpartnered or living with the child's biological father or stepfather. The quality of maternal marital relationships at 14 years was assessed using a short form of the Dyadic Adjustment Scale (DAS) (Cronbach's alpha = 0.88) (Spanier, 1976). Accordingly, mothers were divided into three categories: unpartnered group and partnered mothers with good adjustment or poor adjustment (top 20% with marital disagreement). Combining these two variables, we distinguish five types of structure: intact families with good adjustment, intact family with poor adjustment, reconstructed families (mother and stepfather) following marital disruption (separation, divorce, or biological father's death) with good adjustment, reconstructed families with poor adjustment, and unpartnered mothers (who were divorced, separated, widowed, or never married).

Maternal mental health at the 14-year follow-up was assessed using the short form of the Delusions-Symptoms-States Inventory (DSSI) (Bedford & Foulds, 1978). The DSSI has been validated against the Beck Depression Inventory (BDI) and the Structured Clinical Interview for DSM-IV (SCID), and it has been used in numerous studies (Hammen & Brennan, 2003). For the purpose of this study, mothers were classified as anxious or depressed if they reported three or more of seven symptoms related to anxiety or depression, respectively. Maternal cigarette smoking (smokers/nonsmokers) and alcohol consumption (abstainers/drinkers) were assessed at the 14-year follow-up.

Symptoms of problem behaviors in the adolescents at the 14-year follow-up were assessed using the Youth Self-Report (YSR) (Achenbach, 1991). The YSR is a self-completion questionnaire for individuals aged 11 to 18 years that asks about symptoms in the last six months. The YSR has been

widely used as a measure of child and adolescent behavioral problems in both clinical and research contexts. Subscales used in the current study included internalizing behavior (consisting of 31 items addressing withdrawn behavior, somatic complaints, and anxious/ depressive behavior) (Cronbach's alpha = 0.86), externalizing behavior (consisting of 30 items addressing aggression and delinquency) (Cronbach's alpha = 0.87), and attention problem (consisting of nine items) (Cronbach's alpha = 0.72). In the current study, cases of problem behavior at the 14-year follow-up were defined using 10% cutoffs of scores on the relevant scale (Achenbach & Edelbrock, 1983). The extent of smoking and drinking by the youth at 14 years was assessed via self-report questions concerning the average number of cigarettes smoked and glasses of alcohol consumed per day during the week preceding the survey. Subjects were then divided into categories, nonsmokers/smokers and abstainers/drinkers. Combining these two variables, we created a new variable named adolescent poly-substance use with the option being: neither cigarette nor alcohol (62.2%), either cigarette or alcohol (30.0%), and both cigarette and alcohol (7.8%).

The young person's intellectual development was assessed at the 14-year followup using the Raven's Standard Progressive Matrices (Raven's IQ) (Raven, Court, & Raven, 1996). The Raven's is used as an indicator of IQ. It is a widely used test to assess nonverbal reasoning and general intelligence, applicable to people aged five years and over. In the current study, after obtaining the overall Raven's IQ (mean = 100.05 and standard deviation = 14.94) at 14-year follow-up, we considered one standard deviation below the mean as the cutoff that defined low intellectual capacity.

Dropout from school by adolescents was assessed at the 21-year follow-up by the level of education they had achieved. Options were from primary school to university. Subjects were then categorized into two groups with those who reported not completed high school considered as drop-out from school.

STATISTICAL ANALYSES

We used univariate logistic regression to estimate relative risk (expressed as the odds ratio (OR) and 95% confidence intervals (95% CI)) of using cannabis for each category of self-reported and maternal-reported CSP (Table 1). We first examined the univariate association between self-reported measures of school performance in English, math, and science with young adults' use of cannabis and then repeated the analyses using the computed summary variable. As the outcome comprises three values (cannabis never use, occasional use, and frequent use), we analyzed the data using multinomial logistic regression. This breaks the analysis up into a series of binary regressions comparing each group with a baseline group (high performance and never use of cannabis). In order to examine the impact of other covariates, we progressively developed three multivariate models (Table 3). We computed a likelihood ratio test to examine whether there is a statistically significant difference between results for males and females and found no gender interaction in the apparent associations. We then repeated the likelihood ratio tests to obtain the fully adjusted model that best fit our data. Nonsignificant covariates were not included in the final model.

For the second objective, we tested whether associations between CSP and young adults' use of cannabis is independent of a selected group of possible confounders (Table 3). In Model 1, we adjusted for the child's gender and socio-demographic variables (family income, mother's age, family structure, maternal mental health, and maternal smoking and alcohol consumption measured between the child's birth and 14 years of age). We subsequently controlled for adolescent problem behaviors (including externalizing, internalizing, and attention problems), adolescent smoking and alcohol consumption, and adolescent Raven's IQ at 14 years (Model 2). For testing the impact of a selected group of possible mediating factors, we conducted a two step analysis (Baron & Kenny, 1986). First, we tested the separate associations of the CSP and the outcome with the presumed

mediators (dropout from school). The analyses indicated the candidate mediator was associated with both CSP and young adults' use of cannabis ($p < 0.001$). Therefore, in a further regression model, we controlled the association between CSP and cannabis use for dropout from school (Model 3). All analyses were carried out using SPSS V.13 and STATA V.9.

Of the 5,078 subjects for whom we had self- and maternal-reports of school performance at 14 years, 68.5% ($n = 3,478$) provided data about frequency of use of cannabis as young adults. Measures that predicted loss to follow-up at 21 years included male gender, poor school performance, low SES, maternal smoking, and child externalizing behavior at 14 years. To determine whether loss to follow-up at 21 years affected the validity of our findings, we undertook a weighted analysis using inverse probability weights (Hogan, Roy, & Korkontzelou, 2004). The probability weights were computed from a logistic regression model examining associations between all other covariates used in our primary analyses and having complete data or not. The regression coefficients from this model were then used to determine probability weights for the covariates in the main analyses. The results from subsequent analyses including inverse probability weighting based on these factors did not differ from the unweighted analyses presented here, suggesting that our results were not substantially affected by selection bias.

RESULTS

At the 21-year follow-up, 3,478 young adults provided information about frequency of use of cannabis. Half (50.5%) reported having never tried cannabis. Of the remainder, 37.3% had used cannabis occasionally, while 12.2% reported use of cannabis at least every few days during the month preceding 21-year survey. Of the present cohort of young adults, 30.7% prospectively reported having high school performance at 14 years, 7.9% were classified in low a performance group, and 61.4% were in the average performance category.

Table 1 shows univariate associations between self-reported school performance at 14 years and young adults' frequency of cannabis use. Children with low or average performance in English, math, or science, or overall performance at 14 years were more likely to report occasional or frequent use of cannabis at 21 years. The strongest associations were found for low school performance and frequent use of cannabis (OR = 4.9; 95% CI: 3.3-7.3). There was a similar pattern of association between maternal reported school performance and young adults' use of cannabis.

The associations between a range of childhood and adolescent background factors and young adults' patterns of cannabis use are presented in Table 2. Frequent users of cannabis were more likely to be male and come from more disadvantaged socio-economic positions (young mothers with lower educational background). Children whose mothers were married to the child's biological father at the time of the 14-year follow-up and reported good marital quality were less likely to use cannabis at 21 years compared with those of stepfather families, those whose mothers were experiencing marital disagreement, or those whose mothers were unpartnered at the time child was 14 years old. Table 2 also shows those who reported cannabis use were more likely to have mothers who used tobacco and alcohol at the 14-year follow-up. They were also more likely to have exhibited symptoms of externalizing and attention problems and were much more likely to have smoked cigarettes and drunk alcohol in early adolescence.

Table 3 shows the multivariate associations between self- and maternal-reports of CSP, and young adults' frequency of use of cannabis assessed at 21 years. Adjustment for child's gender and a group of family factors (Model 1) measured between birth and 14 years led to attenuation in the relationship for the maternal report school performance. Further adjustment for adolescent problem behaviors and use of tobacco and alcohol at 14 years (Model 2) measured at child age 14

years considerably reduced the magnitude of association between both maternal and self-report CSPs and frequent use of cannabis. When the association was additionally controlled for drop-out from school (Model 3), there was substantial decrease in the magnitude of associations, with the association for maternal-reported low school performance and frequent use of cannabis becoming nonsignificant. The fully adjusted model indicated that the relationship between low school performance and young adults' use of cannabis was not confounded by a variety of individual and family factors, but a substantial part of the association is explained by child drop-out from school.

SENSITIVITY ANALYSES

We conducted two additional series of analyses to test the validity of the findings presented here. The main threat to the validity of the findings pertains to the measurement of school performance. In addition to the maternal report and selfreport (average of three subjects), we used a separate measure of self-reported overall CSP and examined its association with young adults' use of cannabis. Fourteen-year-old children who had reported having an overall low school performance were more likely to frequently use cannabis in early adulthood, and the pattern of association was similar to that presented already.

Further, in order to test the validity of self-reported use of cannabis, we removed those ($n = 75$) adolescents who had reported use of cannabis by 14 years. After controlling for family and individual factors, the findings were not materially different from those presented in Table 3. In further sensitivity analyses, we used DSM-IV diagnoses of young adults' cannabis use disorders and other illicit drug use disorders measured at 21 years. The new analyses indicated that those who reported low school performance at 14 years were more likely to have cannabis or other illicit drugs use disorders by early adulthood. Adolescents with low school performance at 14 years had $OR = 2.2$ (95% CI: 1.5, 3.2) for having cannabis use disorders and $OR = 1.8$ (95% CI: 1.1, 3.1) for having other illicit drug use disorders by early adulthood. Full adjustment for all possible confounders and mediator presented in Table 3 reduced these associations which became nonsignificant.

Finally, there might be a concern that the measurement of selected confounders was carried out at the same time as the exposure factor. In a complementary analysis we controlled the association between maternal and self-reported CSP and young adults' use of cannabis for similar covariates measured between birth and five years of the child's life. Findings of the new analysis were consistent with those presented in Table 3.

DISCUSSION

We undertook this investigation to address two questions: Does CSP at 14 years predict use of cannabis in early adulthood? If so, is this association independent of the influence of individual and family background and the child's general intelligence? Our findings indicate that school performance at 14 years predicts young adults' frequent use of cannabis. Children who had lower performance in school were more likely to report frequent use of cannabis at 21 years, with the association being stronger for frequent use of cannabis. This association was apparent for a variety of measures of CSP and for DSM-IV diagnosis of cannabis and other illicit drug use disorders in young adults. In addition, the link between CSP and subsequent use of cannabis was independent of possible family and individual confounders and child IQ.

Our finding that CSP at 14 years predicts use of cannabis in early adulthood supports a previous prospective study (Schulenberg et al., 1994). Using structural equation modeling, Schulenberg and colleagues found a significant relationship between high school grade point average and young adults' use of illicit drugs (structural coefficient = - 0.14). However, the findings of the current study

are not in agreement with Poikolainen et al. (2001). This latter study did not find a relationship between high school grade point average and initiation to cannabis use.

The association between CSP and cannabis use might be attributed to various pathways. The first is that both drug use and poor school performance are manifestations of a rejection of conventional social values and are associated with other individual and environmental factors that may increase general tendencies towards deviance and problem behavior (lessor & Jessor, 1977). However, our findings suggest that the relationship between school performance and use of cannabis is independent of several indicators of deviant behavior including externalizing behavior at five years or 14 years, and smoking and alcohol consumption at 14 years.

A second possibility is that cannabis use is a consequence of poorer academic achievement and is used as a way of addressing the frustration and distress resulting from low school performance (Brunswick & Messeri, 1983). Merton (1957) long ago suggested that those who accept dominant societal goals but are unable to attain them are more likely to reject the institutionalized means. Merton suggested that these individuals would turn to deviant means in order to achieve their goals. The findings of the present study indicate that most of the association between CSP and use of cannabis is explained by child dropout from school. An alternative possibility is that poor performance in school may separate the individual from his/her peer group, while fostering affiliation with more deviant teenagers, and it is reasonable to anticipate that a child's peer group may influence the development of substance disorders.

LIMITATIONS

The first limitation of the current study is that we have used self-reported measures of CSP and use of cannabis. This raises the possibility of errors in measurement of either or both exposure and outcome. However, in addition to self-reported school performance, we used the maternal report about CSP. Although maternal- and self-reported CSPs shared a similar pattern of association with young adults' use of cannabis and were associated with subsequent objective school performance (OP score), use of official report of child grade point average could improve the quality of the findings. In regard to the self-report measure of cannabis use, we addressed the possibility of measurement error for the outcome measure in sensitivity analyses employing DSM-IV cannabis and other illicit drugs use disorder at 21 years measured by CIDI-Auto. When we repeated all analyses using the CIDI diagnostic criteria, the results were consistent with those presented in Table 3.

Another limitation is the sizeable (31.5%) reduction in the sample between the 14- and 21-year follow-up. Loss to follow-up may influence our results in two different ways. If the association between CSP and use of cannabis in those lost to follow-up was higher than in the study group, our findings would underestimate the true association. There is a potential threat to the validity of our findings if the association we demonstrated was not evident or was in the opposite direction in those lost to follow-up. Given the likely causal pathways and the positive association reported by other authors, this is unlikely. In the MUSP, it is generally the case that those lost to follow-up would be expected to have a worse outcome (Najman et al., 2005), and it is likely that the results presented here underestimate the true association between CSP and cannabis use. Using the inverse probability weighting (Hogan et al., 2004), previous studies indicated that loss to follow-up between the first phase of the study and the 14-year follow-up has been unlikely to affect the findings of MUSP (Mamun et al., 2005). When we used inverse probability weighting to restore the representation of those lost to follow-up, the results were virtually the same as those presented here, suggesting that selective attrition is unlikely to have affected our findings.

CONCLUSION AND IMPLICATIONS

Within the context of these limitations, our analyses indicate that the level of academic performance in high school children predicts their use of cannabis as young adults, even after the impact of possible family and individual confounders is taken into account. If the association were true and causal, this has significant implications for the prevention of substance use and abuse and its negative consequences. It can be expected that efforts to increase the educational involvement and success of adolescents during high school may have important effects in terms of reducing frequent use of cannabis in young adulthood. Since most of the link between poor school performance and subsequent use of cannabis is mediated by dropout from school, effective interventions for prevention of school dropout are warranted.

ACKNOWLEDGMENTS

The authors thank the MUSP participants, MUSP Research Team, Rosemary Aird, and the rest of the MUSP21 data collection team, MUSP Data Manager Greg Shuttlewood; the Mater Misericordiae Hospital and the Schools of Social Science, Population Health, and Medicine, at The University of Queensland for their support. The core study was funded by the National Health and Medical Research Council (NHMRC) of Australia, but the views expressed in the paper are those of the authors and not necessarily those of any funding body.

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[Author Affiliation]

Mohammad R. Hayatbakhsh, Ph.D., M.D., is a senior research officer at the School of Population Health, University of Queensland, Australia and Qom University of Medical Sciences, Iran. Michael J. O'Callaghan, F.R.A.C.P, is with the Child Development and Rehabilitation Services, Mater Children's Hospital, Brisbane, Australia. Konrad Jamrozik, D.Phil, is professor of Evidence-Based Health Care and head of the Division of Health Systems, Policy and Practice at the School of Population Health, The University of Queensland. Jake M. Najman, Ph.D, is professor of Medical Sociology and director of QADREC at School of Population Health and Sociology, The University of Queensland. Abdullah A. Mamun, Ph.D., and Rosa Alati, Ph.D, are with the School of Population Health, The University of Queensland, Brisbane, Australia. William Bor, F.R.A.N.Z.C.P, is Director of Mater Centre for Service Research in Mental Health, Mater Hospital, Brisbane, Australia.