Mental health status mobility in Canada: evidence from panel data analysis

by

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An essay submitted to the Department of Economics

in partial fulfillment of the requirements for

the degree of Master of Arts

Queen's University

Kingston, Ontario, Canada

August 2010

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August 10, 2010

Abstract

In this paper I follow the methodology laid out in Hauck and Rice (2004) to obtain empirical estimates of mental health mobility in Canada using data from the National Population Health Survey (NPHS). I determine whether mobility differs across socioeconomic groups like income, educational attainment, age, and general health status. I make use of the NPHS distress scale, an index created from a 6-item questionnaire on psychological distress, as a measure of mental health. This scale is similar to the 12-item version of the General Health Questionnaire (GHQ). Using seven cycles of the NPHS, I determine that although there is considerable mobility in mental health in Canada, there still appears to be differences in mental health status across socioeconomic groups. I also demonstrate how current mental health status is clearly linked to adverse childhood experiences. This analysis of Canadian data has implications for the design and objective of mental health treatment programs in Canada.

JEL classification: I12 C23

Keywords: mental health; mobility; health inequalities; panel data models; Canada

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Contents

1 Introduction

The failure to understand why some people age well and others do not is a fundamental gap in the field of medical science; mental health is at the heart of this issue. Mental health problems are highly stigmatized in Canada and this stigmatization is an impediment to the study of mental health and its correlation to longevity. The last major review of the Canadian health care system suggested that mental health and its connection to aging is "the orphan child of health care" (Romanov, 2002). Mental health status is a key indicator of individual and population health: our understanding of its prevalence, persistence and effects on population health in Canada is imperative for the enhancement of our health care system (Dunstan et al., 2006).

In Canada an estimated 20 percent of people will suffer from mental illness in their lifetime; the remaining 80 percent will be affected by it through a relationship with someone who suffers from mental illness (Health Canada, 2002). Recent evidence from the Canadian Community Health Survey shows that roughly seven percent of adults in Canada have been diagnosed with a mental illness and that another six percent suffer but remain undiagnosed (Lim et al., 2008b). Mental illness has serious impacts on the quality of life of Canadians but it is also a huge economic burden on our society. This burden is made up of direct costs to our health care system as well indirect costs from reductions in *health-related quality of life* (HRQOL) to productivity. Estimates demonstrate that Canadians are "paying" more than $52 billion a year to deal with mental illness (Lim et al., 2008a).

Despite evidence of the serious implications of mental illness on our society this issue has received limited consideration from Canadian policymakers in the recent past; but with a growing number of studies highlighting the economic burden of mental health, policy intervention is increasingly imminent. Despite the increased attention, there is inadequate analysis of the determinants and mobility of mental health status in Canada. Canada pales in comparison to the UK where a number of studies have been done using the British Household

Panel Survey (BHPS).[1]

I follow the methodology developed by Hauck and Rice (2004) and apply this model, which captures both the state dependence and the contributions of individual effects, to mental health mobility in Canada. I use data from the National Population Health Survey (NPHS). I also assess whether negative childhood experiences affect the mental health status of adults.

I show that in Canada there is substantial mobility in mental health status for both men and women. Sub-sample analysis suggests that mobility differs across age and income groups and that this difference is greater for men. Differences in mobility are also explained by deviations in the initial mental health scores across socioeconomic groups. I also demonstrate how childhood trauma have a significant effect on an individual's mental health status as an adult and that the lower average of mental health status for women in this sample is the result of a higher incidence rate of adverse events in childhood.

In the first section of the paper I discuss the results of literature that has used Canadian data on mental health and go over new techniques for capturing mental health mobility using longitudinal data. I then present the data and variables used in my paper. Next, I provide the results of descriptive techniques for analyzing mobility. Following this descriptive mobility analysis, I discuss the techniques used for empirical estimation of mobility. In the next section, I provide the results of both static and dynamic panel models of mental health mobility. The paper closes with some concluding statements on targeting mental health interventions in Canada.

2 Literature Review

Analysis of mental health status in Canada has generally been restricted to studies in medicine and psychology.[2] The most comprehensive analysis of mental health determinants

[1] See Wildman (2003); Propper et al. (2005); Dunstan et al. (2006)

[2] Although it is not directly related to mental health, van Doorslaer and Jones (2003) use the health-utility index in the first cycle of NPHS to demonstrate how self-assessed health survey results can be rescaled to

using Canadian data was done by Stephens et al. (1999). This study made use of the first cycle of the NPHS to estimate multinomial logistic models for four measures of positive mental health (sense of coherence, self-esteem, mastery, and happiness) as well as four measures of mental health problems (depression, distress, distress affects life, and cognitive impairment). The results suggest that childhood trauma, current stress, and traumatic life events have the most consistent negative association with the positive mental health measures and a positive association with mental health problems. Conversely, a measure of social support taken from the survey was positively correlated with good mental health and had a significant negative effect on all but one of the mental health problems. This study also determined that education was linked to better mental health but did not appear to be a factor in the measure of mental health problems. Similarly, age was not shown to have a consistent effect on any of the categories except "sense of coherence". While Stephens et al. (1999) represents an important first assessment of the determinants of mental health status in Canada, the study does not examine important factors such as income, marital status or employment status. Since the study makes use of cross sectional data it is not able to confirm whether many of the intertemporal variables (i.e., life events, childhood trauma) have a causal relationship; nor can they control whether individual time-invariant heterogeneity such as genetics or initial health endowments, are correlated with the explanatory variables.[3]

Other studies using Canadian data have been more targeted. Patten (2001) used the first two cycles of the NPHS to verify whether there was a connection between reporting a long-term medical condition in the primary cycle and major depression in the second cycle. Using a dichotomous logistic specification, Patten found that long-term conditions were significantly associated with major depression after controlling for age and gender. A follow-up study by Patten and Beck (2004) focused on major depression and how it affected health care utilization and antidepressant use; this investigation primarily exploited the

provide more accurate measures of general health status.

[3]Correlation between regressors and the individual time-invariant fixed effects can result in inconsistent estimation of the parameters. For a more serious treatment of this issue see Wooldridge (2002).

cross-sectional dimension of the NPHS data and included utilization variables using the same controls of age and gender. This study did not investigate mental health mobility or any other longitudinal topic.

The differences in mental health status between rural and urban areas is another dimension that has been examined in the mental health literature using the NPHS data. Wang (2004) performed cross-tabulations and logistic regressions based on the 1998-99 cycle; this study determined that there were differences in major depression episodes for urban and rural areas. The differences were especially acute for white and non-immigrant individuals.

These investigations have improved our understanding of mental health but they have not simultaneously controlled for potentially important covariates (such as income) nor have they tried to address mobility in mental health status in Canada making use of longitudinal evidence from the seven cycles of the NPHS.

The majority of the literature on the economics of mental health in Canada has focused on the financial burden of mental illness.[4] But it is also important to determine whether certain sub-populations are more likely to experience poor mental health. Measuring the consistency of mental health status in Canada will help policymakers identify where to focus treatment programs. In order to conduct this analysis, it is necessary to have panel data to control for the concerns noted above (i.e., childhood trauma, income, individual fixed effects) and to derive measures of mobility.

Fortunately, Hauck and Rice (2004), using an index constructed from questions asked in the BHPS called the 12-item General Health Questionnaire (GHQ), demonstrated that it is possible to analyze the mobility of mental health status using econometric procedures. This analysis included explanatory variables on transitory and permanent income as well as age, marital status, employment, education, household size, and social class. Hauck and Rice used econometric methods borrowed from literature on income dynamics to estimate state dependence and the contribution of unobserved individual effects to the mobility of mental

[4]See Stephens and Joubert (2001); Lim et al. (2008a,b); Jacobs et al. (2008)

health status in the UK.[5] Similar techniques could be applied to Canadian data on mental health status.

The relationship between early childhood trauma and adult mental health has not been explored in Canada. Felitti and Anda (2009) conducted an adverse childhood experiences (ACE) study of 17,000 individuals at the Kaiser Permanente's Department of Preventive Medicine in San Diego. Their study looked at 8 categories of adverse childhood events and gave an ACE score to each individual; the score was a total of the number of events an individual faced in the first eighteen years of their life. The ACE events included in the study related to abuse (emotional, physical, contact sexual abuse) and household dysfunction (domestic violence, alcoholism or drug abuse in household, imprisoned household member, household member suffered from a psychiatric disorder, not raised by both biological parents).[6] They connected individuals' ACE scores to current health and well-being using the responses of their study population. In terms of mental health they found that there was a strong link between ACE scores and chronic depression; high ACE scores were also connected to suicide attempts. Felitti and Anda (2009) also showed that "54% of current depression and 58% of suicide attempts in women can be attributed to adverse childhood experiences". Evidence from this case study shows that controlling for these events is important in describing mental health status. The NPHS includes seven questions that address adverse childhood events; by including these controls in my analysis, I will be able to determine how these events relate to current mental health status in Canada.

3 Data

The NPHS is a longitudinal survey of Canadian households that collects information related to the health and sociodemographic status. For my analysis I use cycles one through seven of this survey. The first cycle was conducted in 1994/1995 and 17,276 people were included

[5]For more on the income dynamics literature see Lillard and Willis (1978)

[6]In the second wave of their study, Felitti and Anda (2009) also included a category for neglect (physical, emotional).

in the sample. They are interviewed every two years until the survey completes ten cycles. I restrict my sample to people aged 18 and older in the initial cycle who do not have any missing information for the variables described below. This sample is repeated for the subsequent cycles.[7]

The measure of mental health that I use in this paper is borrowed from the NPHS: it is an index created from a 6-item questionnaire covering topics like the ability to concentrate, sleep loss, enjoyment, and feelings of loss and self-worth. This measure is similar to the GHQ measure used by British studies on this topic. Each of the questions are measured on a 4-point scale; the responses are compiled to give an index score from 0 to 24 with higher values indicating higher levels of distress. The scale used in the NPHS is described in Kessler et al. (2002). The authors devised both a 10-item questionnaire (K10) and the short-form 6-item version (K6) to be included in the US National Health Information Survey (NHIS). These dimensional scales were designed to screen for mental illness and other non-specific psychological distress. Furukawa et al. (2003) demonstrated that both the K10 and K6 were more effective than the 12-item GHQ at diagnosing mental illness. The K10 was also shown to be slightly better than the K6 but the latter was more resistant to subsample variation (Furukawa et al., 2003). The NPHS included the K6 scale in the first wave and according to these results, we should be able to analyze mental health status mobility in Canada.

For a concise description of the distress index as well as the explanatory variables I use in my analysis refer to Table A.1. To generate the logarithm of real per capita income in this analysis I use current household income given by respondents in the NPHS. Categorical income is available for all seven waves and a continuous income variable is available for the last five waves. I use the continuous income when available and supplement it with the categorical variable by giving individuals the median income from the category they

[7]To partially account for attrition and to correct for sampling methods, I weight the regressions in this paper using the adjusted full-sample weights included in the NPHS. I use probability weights except in the MLE models where importance weights had to be constructed to add up to nT for each of the sub-samples used.

selected.[8] The income variable is then adjusted using the CPI index and the number of individuals in each household. Taking the logarithm of income allows for concavity in the relationship between mental health and income. One potential problem with including this regressor is the possibility of endogeneity between mental health and income. Hauck and Rice (2004) note that including a proxy for permanent income (the time-average of the income variable across all waves of the survey that a household is present for) limits the possibility of simultaneous determination of income and mental health.[9] Still, this does not completely eliminate the possibility that income is endogenous.

The other variables I include in the analysis are age— its square and cube (to capture non-linear effects)— marital status dummies (never married, divorced/separated, widowed), dummies for highest educational attainment (high school diploma, post-secondary degree), household size, the number of children in the household between 0 and 5 and a separate variable for the number of children aged 6 to 11.[10] Although other studies have found social support to be a significant determinant of mental health, the index of tangible social support included in the NPHS is not available until the third cycle and is therefore omitted as it would limit the panel aspect of the data. I also include indicator variables for daily physical activity (if an individual engages in more than 15 minutes of strenuous exercise each day) and unemployment.

The NPHS includes seven questions relating to adverse events that occurred while an individual was still a child or teenager. These questions are present in three of the seven waves. The categories include: a significant hospital stay, parental divorce, parental unemployment, a traumatic experience, being sent away from home for misbehaviour, parental abuse of alcohol or drugs, and physical abuse. I use these questions to generate time-invariant indicator variables; I use them in the model of mental health status to see how childhood

[8] I combined the two lowest categories, which resulted in 11 categories that range from $2,500 to $110,000

[9] I also estimated a model for the balanced panel which included this proxy for permanent household income. These estimates are provided in Tables A.5 and A.6.

[10] I scaled the non-linear age terms by dividing the square term by 100 and the cubic term by 10000. The NPHS does not include sufficient information to control for the number of children between the ages of 12 and 18 in each household.

events impact mental health in adulthood.

4 Health-related attrition and non-response

Panel data often suffers from significant attrition and non-response. It is a tormenting process to keep track of the same group of individuals over long periods of time and the NPHS is no different. Non-response can be problematic for econometric estimation when it is linked to health or other socioeconomic characteristics. This form of sample selection bias can jeopardize the estimates. Tables 1 and 2 present analysis of attrition and non-response across the seven waves of the NPHS.

Table 1 displays the wave-to-wave attrition across the full sample; it also displays attrition as disaggregated by gender. The table includes: the weighted number of observations at each wave, the number of drop-outs and the number of participants to re-join the survey. The attrition and net attrition rates are given along with the survival rate.[11] In the full sample the raw attrition rate is highest between waves 6 and 7 at 20.1%; the average rate between each wave is 17.7%. The net attrition rate, however, is highest for the second wave of the survey at 11.7%; in general it is below 10%. The wave-to-wave attrition rates are also broken down by quartile of the K6 distress index in the previous wave: higher quartiles represent worse mental health. The attrition rate does not differ dramatically across the lowest three quartiles and it is often close to or below the raw attrition rate in the entire sample. There is evidence that those with poor mental health in the previous wave are more likely to drop out in the preceeding wave. The difference between the attrition rates for the fourth quartile and the full sample is typically within 2-3%. Comparing the attrition rates for men and women, it is clear that men have higher sustained attrition across the seven waves of the survey: the wave-to-wave average for men is 18.5% while it is 17.1% for women. The difference in attrition rates between those in the fourth K6 quartile and the other three quartiles is also more pronounced for men. Though it is important to consider the differences

[11] Raw attrition rates exclude re-joiners and the net attrition rate includes re-joiners.

Table 1 – Distress index sample size, drop outs, re-joiners and attrition by wave and previous mental health status

							DIS 4	DIS 3	DIS 2	DIS 1
Wave	No. Ind.	Drop outs	Re-joiners	Raw attrition rate (%)	Net attrition rate (%)	Survival rate (%)	Attrition rate (%)	Attrition rate (%)	Attrition rate (%)	Attrition rate (%)
All data										
1	17800000									
2	15700000	2973443	895259	16.69	11.67	88.33	18.28	16.60	15.19	16.50
3	14600000	2441468	1332884	15.51	7.04	82.11	17.56	14.20	12.63	15.53
4	13200000	2615497	1206347	17.88	9.63	74.20	20.45	16.20	16.83	17.49
5	11900000	2444508	1159926	18.49	9.72	66.99	20.54	16.58	17.23	18.38
6	11100000	2117427	1239095	17.74	7.36	62.06	18.67	18.26	15.68	17.46
7	9870946	2227359	1041605	20.14	10.72	55.41	23.16	18.81	17.11	20.09
Men										
1	8401844									
2	7480576	1397917	476649	16.64	10.97	89.03	19.52	17.75	13.38	16.83
3	6912691	1222274	654389	16.34	7.59	82.28	18.52	15.02	13.39	16.29
4	6173074	1325125	585508	19.17	10.70	73.47	20.80	18.75	17.41	20.59
5	5550061	1213277	590264	19.65	10.09	66.06	23.72	15.95	15.39	23.06
6	5120456	1055259	625654	19.01	7.74	60.94	20.73	21.66	17.69	17.95
7	4655604	1020433	555581	19.93	9.08	55.41	22.44	18.60	17.16	22.65
Women										
1	9413688									
2	8256772	1575526	418610	16.74	12.29	87.71	17.19	15.71	16.47	17.21
3	7716073	1219194	678495	14.77	6.55	81.97	16.55	13.60	12.91	15.24
4	7046540	1290372	620839	16.72	8.68	74.85	19.43	13.32	15.62	15.78
5	6384971	1231231	569662	17.47	9.39	67.83	17.80	17.54	15.80	17.69
6	5936244	1062168	613441	16.64	7.03	63.06	17.72	15.36	14.25	17.29
7	5215342	1206926	486024	20.33	12.14	55.40	22.61	17.35	19.23	19.59

[1] DIS i is a quartile of the distress index at $t-1$, $i = 1, 2, 3, 4$. [2] Attrition calculations were made using frequency weights generated from the survey probability weights.

in attrition rates across the quartiles they are typically small. Overall, I find evidence of mental health-related attrition but the effect on attrition is small.

I provide further non-response analysis in Table 2, which shows the overall attrition rate across all seven waves. In Table 2, I also give attrition rates specific to several socioeconomic categories. The average attrition rate across the seven waves is 44.6%. As expected, attrition is much higher for the oldest age quintile (>62) at 77.4%; the attrition for the youngest quintile is 44.0%. The higher attrition for older individuals may be connected to health through deaths, mental illness and other conditions that prevent them from continuing participation in the survey. Attrition is higher for individuals with lower income and less formal education. Adults without a high school degree have a 68.9% attrition rate compared to only 21.3% for those with a post-secondary degree. Attrition rates across marital status groups do not vary greatly except for those who are single and have never been married. This is likely a result of participants in this category getting married during the 15-year period covered by the NPHS.

Attrition rates vary across socioeconomic characteristics but these results do not seem to be connected to mental health-related attrition. When divided into quartiles of the distress index there is little variation in attrition rates across gender, age and income quintiles, marital status, and educational attainment. The highest age quintile is an exception as attrition rates vary more significantly across distress quartiles and the highest rate is for those that began the survey with the worst mental health. Like the results in Table 1, the fourth quartile of the distress index tends to have slightly larger attrition rates than the other quartiles. The widowed category is also an aberration but this may be due to the participants becoming widowers over the course of the NPHS sampling period.

The results of the attrition analysis of the NPHS are similar to the findings of Hauck and Rice (2004) using the BHPS. Most importantly, the degree of mental health-related attrition is limited across socioeconomic categories other than age. Hauck and Rice (2004) note that these differences are not large enough to compromise the regression estimates

Table 2 – Distress index attrition rates over 7 waves by gender, age, income, education, and marital status

	DISTRESS (%)	DIS 4 (%)	DIS 3 (%)	DIS 2 (%)	DIS 1 (%)
All data	44.59	51.42	45.04	43.83	49.51
Gender					
Men	44.59	51.77	46.57	42.09	54.23
Women	44.60	49.48	43.38	45.43	49.25
Age quintile					
1 (≤ 27)	44.03	46.08	41.87	44.98	44.10
2 (> 27, ≤ 37)	39.58	44.33	38.86	38.94	37.18
3 (> 37, ≤ 47)	37.56	41.26	35.52	31.24	40.70
4 (> 47, ≤ 62)	46.32	53.94	45.06	43.18	44.92
5 (> 62)	77.44	85.22	79.52	72.68	75.12
Income quintile					
1	55.51	59.15	51.80	51.97	55.72
2	54.53	62.50	52.96	49.09	60.53
3	43.82	47.71	40.91	42.98	45.01
4	40.61	44.27	38.20	36.38	43.18
5	38.89	45.13	36.02	35.59	40.83
Education					
Degree	21.31	14.95	23.11	25.74	33.73
High School	54.85	59.21	55.47	56.64	58.94
Less than high school	68.94	76.53	68.90	65.61	69.46
Marital Status					
Widowed	28.45	17.62	-11.83	37.24	61.28
Single	89.13	90.57	88.49	88.88	89.62
Divorced/separated	29.19	27.79	25.72	24.96	48.18
Married/Couple	34.13	40.02	37.40	32.52	40.00

[1] Raw attrition rates are used based on the number of individuals in wave 1 compared to wave 7. [2] DIS i is a quartile of the distress index at the first wave, $i = 1, 2, 3, 4$. [3] Attrition calculations were made using frequency weights generated from the survey probability weights.

obtained later in this paper.[12] Hauck and Rice (2004) suggest that by stratifying the data by socioeconomic characteristics, the effect of attrition is muted. Jones et al. (2007) propose that generating a model specific inverse probability weighted (IPW) estimator can correct for health-related non-response. However this approach is typically used in non-linear models. To partially adjust for non-response in the NPHS balanced panel, the longitudinal full-weight

[12]No studies focusing on the impact of distress-related attrition on regression estimates have been done using the NPHS. However, Hauck and Rice (2004) note that correcting regressions for self-assessed health-related attrition in the BHPS did not have a significant effect.

is implemented in all the regression models. These weights are corrected for non-response at each wave of the survey according to gender, income, mental health, physical health, age, and other socioeconomic characteristics (Statistics Canada, 2008). The use of these weights will also mitigate potential sample selection bias.

5 Descriptive Analysis

The sample means of the dependent variable and regressors for all data and for men and women are given in Table 3. I also separate the sample into both balanced and unbalanced panels. The NPHS sample is relatively congruent across both the balanced and unbalanced panels. There is, however, a higher proportion of individuals with post-secondary degrees in the balanced panel (43.7% compared to 38.4%). The average age is also slightly younger in the balanced panel. Men reported better mental health status (lower distress scores) than women. Men are slightly younger in the unbalanced panel and are members of households with higher income. They are also less likely to be widowed and more likely to be married. In contrast, women experience more adverse childhood events than men, except for having to spend more than two weeks in a hospital due to an illness. These differences are especially pronounced in the balanced panel. In fact, women are more than twice as likely to suffer physical abuse as children. These results support the findings of Felitti and Anda (2009) that women are more likely than men to experience a large number of adverse childhood events.

The first method for describing observed mobility in mental health is through a transition matrix. I provide transition matrices for men and women in the balanced panel in Table 4. The rows of the matrices correspond to previous mental health state while the columns represent the current state. The sample for men and women are each divided into quartiles of the distress index at time t. Mobility can then be observed by looking at the magnitudes of the diagonal elements and those adjacent to the diagonal in comparison to elements further

Table 3 – Regressor means for the balanced and unbalanced NPHS panels

	Full Sample		Men		Women	
	Unbalanced	Balanced	Unbalanced	Balanced	Unbalanced	Balanced
Distress	2.711	2.577	2.373	2.190	3.011	2.921
Income	9.635	9.729	9.717	9.818	9.563	9.650
Age	47.616	45.371	46.899	45.273	48.250	45.458
HH size	2.838	2.939	2.876	2.979	2.805	2.904
No.Child 05	0.198	0.229	0.200	0.230	0.196	0.228
No.Child 611	0.246	0.289	0.237	0.279	0.254	0.298
Daily exercise	0.310	0.314	0.312	0.311	0.309	0.317
Unemployed	0.036	0.033	0.040	0.033	0.032	0.033
Married	0.712	0.730	0.725	0.747	0.700	0.714
Never married	0.115	0.103	0.130	0.110	0.102	0.097
Divorce/separated	0.106	0.113	0.108	0.110	0.105	0.115
Widowed	0.067	0.054	0.037	0.032	0.093	0.073
Rural	0.192	0.196	0.202	0.208	0.183	0.186
High school	0.148	0.152	0.135	0.140	0.159	0.162
Degree	0.384	0.437	0.398	0.438	0.371	0.437
Childhood events						
Illness	0.205	0.217	0.219	0.236	0.193	0.201
Parent divorce	0.129	0.144	0.119	0.124	0.138	0.161
Parent unemp	0.168	0.183	0.165	0.175	0.170	0.190
Trauma	0.288	0.311	0.233	0.237	0.336	0.376
Sent away	0.029	0.032	0.030	0.032	0.029	0.032
Parent addict	0.180	0.203	0.163	0.164	0.195	0.237
Phys. abuse	0.104	0.120	0.067	0.073	0.137	0.162

[1] The balanced panel includes only those individuals who are present in all 7 waves. The unbalanced panel uses all information available for individuals who were present in the first wave.
[2] Summary statistics were calculated using frequency weights generated from the survey probability weights.

away from the diagonal. For example, roughly 37% of the men in the 4th quartile (worst mental health) at time t move two quartiles in the next period. For men in the 1st quartile, 28% move at least two quartiles in the next period. Of men in the middle quartiles, 17% and 30% remain in those quartiles respectively in the next period. The transition probabilities for women are similar, although the average magnitude of the diagonal is slightly larger than for men. This analysis is also done for the unbalanced panel and the results are presented in Table A.2. The unbalanced panel results suggest similar mobility across quartiles. The transition matrices illustrate that adults are more likely to maintain their previous mental

health status but there is still evidence of substantial mobility.[13]

Table 4 – Transition matrices for NPHS balanced panel

DISTRESS quartile	1	2	3	4	N
(a) *Men*					
1	0.626	0.137	0.147	0.089	4179
2	0.454	0.173	0.245	0.128	1675
3	0.318	0.173	0.303	0.205	2607
4	0.181	0.105	0.267	0.447	2369
N	4636	1561	2450	2183	10830
(b) *Women*					
1	0.563	0.275	0.094	0.068	4574
2	0.329	0.379	0.181	0.112	4691
3	0.203	0.341	0.244	0.212	2821
4	0.117	0.196	0.208	0.480	3214
N	5067	4625	2634	2974	15300

[1] The balanced panel includes only those individuals who are present in all 7 waves. [2] Transition probabilities are unweighted.

6 Methodology

I follow the modeling and estimation procedures that are outlined in Hauck and Rice (2004) who use data from the BHPS. This study reveals how the maximum likelihood random effects (RE) specification can be used to obtain measures of mobility in mental health status. The estimates of the variance components from the RE model are used to capture this mobility. This study identifies a second method for measuring mobility: it uses dynamic panel models and includes a lagged dependent variable as a regressor to derive an estimate for the persistence of mental health. I will take these approaches to the measures of mental health status taken from the NPHS survey.

[13]Hauck and Rice (2004) remark that the choice of the quartile cut-points is arbitrary and so the size of the group can influence observed mobility or persistence in the data. My analysis is also subject to this phenomenon.

6.1 Variance component models

In order to estimate a RE specification of the mobility in mental health status in Canada, I specify the following empirical model:

$$h_{it} = X'_{it}\beta + Z'_i\gamma + \eta_i + \epsilon_{it}, \quad i = 1, 2, \ldots, n; \quad t = 1, 2, \ldots, T_i \tag{1}$$

where h_{it} is the mental health score for the ith individual at time t. X_{it} are the time-varying regressors used in the model while Z_i are the time-invariant explanatory variables. The error term is made up of two components: $\eta_i + \epsilon_{it}$. The former is the individual fixed-effect that is assumed to be constant over time and orthogonal to the regressors in the RE model.[14] The latter is the usual independent-identically distributed (i.i.d.) error component. β and γ are the two vectors of parameters to be determined through estimation procedures.

The RE model relies on the orthogonality between the individual-fixed effect and the regressors to derive consistent estimates. This can be problematic in panel data and so a Hausman test is performed to see if this assumption is validated.

The estimates of the two components of the variance term from the RE model can then be used to capture the degree of mental health status mobility in the data. The total variation in mental health status conditional on the set of regressors is given by:

$$var(\eta_i + \epsilon_{it}) = \sigma^2_\eta + \sigma^2_\epsilon \tag{2}$$

Relying on the error term being i.i.d., the intra-unit covariance between two observations is

$$cov(\eta_i + \epsilon_{it_1}, \eta_i + \epsilon_{it_2}) = cov(\eta_i, \eta_i) = \sigma^2_\eta \tag{3}$$

[14] This assumption is often untenable in applied work and estimating models that allow the individual effects to be correlated with the regressors, such as the Mundlak-Wooldridge specification, circumvents this problem (Jones et al., 2007).

It follows that the correlation between two such observations can be expressed as

$$\rho = \frac{\sigma_\eta^2}{\sigma_\eta^2 + \sigma_\epsilon^2} \tag{4}$$

Hauck and Rice (2004) claim that if the variance due to the fixed-effect, σ_η^2, is large relative to the total variance then this will lead to a higher correlation, ρ. A higher correlation suggests that mental health status for individuals is more persistent and that there is lower mobility. If most of the unexplained variation in mental health status is made up by the idiosyncratic component, σ_ϵ^2, then there is higher mobility and less persistence in mental health status. This procedure is followed for both measures of mental health status in the NPHS and I estimate equation (1) using maximum-likelihood estimation (MLE).

6.2 Dynamic panel models

The previous model provides a measure for the mobility due to the unobserved heterogeneity among individuals. Another factor that can effect mobility in mental health status is the level of mental health an individual reported in the previous period. This state dependence is another factor of mobility. In order to estimate state dependence for mental health status in Canada, I add the lag of mental health status to the regressors of equation (1). The resulting dynamic panel model is:

$$h_{it} = \lambda h_{it-1} + X_{it}'\beta + Z_i'\gamma + v_{it}, \quad i = 1, 2, \ldots, n; \quad t = 1, 2, \ldots T_i \tag{5}$$

where the regressors have the same definition as in the earlier model.

Following the framework laid out by Hauck and Rice (2004), I estimate (5) by OLS first. The resulting OLS estimates of (5) tend to be biased upward if there is serial correlation in v_{it}. This results from the fact that the OLS estimate of λ is the combined effect of both state dependence and the correlation between h_{it} and the individual error term. By specifying the model with a lagged dependent variable, the other explanatory variables now represent

the effect of new information on the dependent variable because we are now conditioning on their history (Greene, 2002). When λ is relatively close to zero then there is high mobility, while a coefficient that is both positive and large would suggest that there is low mobility.

In order to disaggregate the components of mobility into state dependence and individual heterogeneity, Hauck and Rice (2004) consider the total error term as it was in the RE model, $v_{it} = \eta_i + \epsilon_{it}$. The first method for demarcating the two components of mobility involves taking the first difference of equation (5) in order to remove the individual fixed-effect. However this method also eliminates the time-invariant regressors present in Z_i; it also introduces a correlation between the first-differenced lagged mental health variable $(h_{it-1} - h_{it-2})$ and the idiosyncratic error term $(\epsilon_{it} - \epsilon_{it-1})$. In order to control for this correlation, the model in first differences can be estimated by a generalized method of moments (GMM) instrumental variables (IV) estimator. The Arellano and Bond GMM IV procedure uses lagged levels of the dependent variable as instruments for the lagged first differences (Arellano and Bond, 1991). This allows the number of instruments and the number of moment conditions used in the estimation procedure to expand as the t-dimension of the panel increases. I estimate the first-differences of equation (5) with the GMM IV procedure and perform both a test for second-order autocorrelation and the Sargan test of over-identifying restrictions.

The difficulty with the GMM IV model identified by Hauck and Rice (2004), is that it does not give us an estimate of the contribution of individual heterogeneity to mental health status mobility. If the model is augmented by using the conditional maximum likelihood estimator (CMLE), an estimate of this effect can be computed by estimating equation (5) in levels. One drawback of this method is that in order to perform the CMLE procedure the distribution of the unobserved individual effect needs to be completely specified. This means that the CMLE is sensitive to misspecification.[15] Hauck and Rice (2004) suggest modeling

[15]For a complete treatment of the assumptions and asymptotic properties of the CMLE see Wooldridge (2002)

the distribution of the individual effects as

$$\eta_i = \alpha + \alpha_1 h_{i0} + \alpha_2' \bar{X}_i + u_i, \quad u_i \sim N(0, \sigma_u^2) \tag{6}$$

where $\bar{X}_i$ is the time average of the time-varying explanatory variables for individual i and h_{i0} is the initial mental health status observation for individual i. By substituting (6) into equation (5) gives the model a RE structure with h_{i0} and $\bar{X}_i$ added in as regressors. This model estimates a separate coefficient for both state dependence, λ, as well as the persistence of mental health status due to the unobserved individual effects, ρ. Additionally, the estimate of α_1 captures the effect on an individual's initial mental health status "endowment" on their current level of mental health. Deriving consistent estimates by parameterizing η_i as shown above in equation (6), relies on the introduction of h_{i0} controlling for any of the serial correlations between η_i and the other regressors. I use an individual's initial mental health status as given by the K6 scale as a proxy for h_{i0}. If this initial observation for mental health status is a poor representation of an individual's "true" initial mental health "endowment" then this can lead to inconsistency. Initial mental health is conceivably connected to age and thus this proxy may represent a different "true" value across the sample population because people began the survey in different age cohorts.

7 Results

I present the results for the various specifications of mental health status mobility in this section. Since mental health differs by gender, I present the estimates for men and women separately. Additionally, I explain in detail the relationship between adverse childhood experiences and adult mental health status as observed in the results of NPHS. I also compare the Canadian estimates of mental health mobility to those derived using the BHPS.

7.1 Mental health status mobility

Tables 5 and 6 present the coefficient estimates for the variance component, OLS, GMM IV, and the CMLE models for men and women respectively using the K6 distress index. For men, the results of the Hausman test indicate that there is strong evidence to reject the null hypothesis that the difference between the random and fixed effects coefficients is not systematic. However for women there is not evidence to reject the null hypothesis at conventional levels.[16] This suggests that the within-individual means transformation is not enough to parameterize the time-invariant fixed effects in the RE model for men.[17] This analysis suggests that the variance components MLE model estimates should be given less weight when deciding the parameters for capturing mental health status mobility in Canada.

Looking at the coefficients in general, we find that income, unemployment, marital status, living in a rural area, and daily exercise are significant factors for men. Age is significant in some of the specifications for women while living in a rural area proved to be insignificant. There is some evidence that men living in rural areas have slightly better mental health than those in urban areas but the coefficient has small economic significance.

Individuals with higher household income have better mental health but this relationship is not significant in the first difference specification or when initial mental health status is included in the model. Income carries more economic significance for women than men; in fact, the coefficient on the proxy for permanent household income is larger for women by a factor of 4 in the CMLE specification. When permanent income is included in all of the models contemporaneous income is no longer significant. However changes in permanent income are significant in the MLE, OLS, and CMLE specifications. When lagged mental health is included, it lowers the estimate on permanent income. Therefore conditioning on previous mental health state weakens the effect of changes in permanent income on current

[16] In the unbalanced NPHS panel for women there is sufficient evidence to reject the null hypothesis of the Hausman test comparing random and fixed effects.

[17] Hauck and Rice (2004) failed to reject both of their Hausman tests for the BPHS data: this may be due to their larger sample size or longer panel length (11 waves).

Table 5 – Mental health status mobility using NPHS balanced panel: Men

	MLE (1)	OLS (2)	GMM IV (3) 1st diff	CMLE (4)
$\text{Distress}_{i,t-1}$		0.405 [0.017]	0.066 [0.026]	0.134 [0.012]
Income	-0.129 [0.040]	-0.140 [0.052]	0.081 [0.067]	-0.021 [0.050]
Perm income				-0.179 [0.089]
Age	-0.053 [0.051]	-0.032 [0.067]		0.311 [0.110]
Age^2	0.020 [0.105]	0.040 [0.132]	0.174 [0.082]	-0.211 [0.157]
Age^3	0.012 [0.070]	-0.022 [0.083]	-0.093 [0.065]	0.149 [0.103]
HH Size	-0.001 [0.026]	0.028 [0.043]	0.038 [0.065]	0.047 [0.034]
No.Child 05	-0.095 [0.048]	-0.108 [0.072]	-0.077 [0.119]	-0.060 [0.060]
No.Child 611	-0.035 [0.043]	-0.058 [0.062]	0.021 [0.106]	0.003 [0.053]
Unemployed	0.518 [0.118]	0.621 [0.273]	0.142 [0.330]	0.359 [0.140]
Never married	0.430 [0.093]	0.374 [0.150]	0.307 [0.208]	0.290 [0.100]
Divorced/separated	0.433 [0.091]	0.511 [0.131]	0.108 [0.238]	0.308 [0.092]
Widowed	0.290 [0.137]	0.291 [0.170]	0.083 [0.388]	0.242 [0.137]
High school	-0.019 [0.114]	-0.012 [0.097]		-0.022 [0.098]
Degree	0.001 [0.075]	0.035 [0.071]		0.008 [0.068]
Rural	-0.153 [0.068]	-0.158 [0.066]		-0.135 [0.067]
Daily exercise	-0.128 [0.049]	-0.182 [0.066]	-0.075 [0.094]	-0.103 [0.058]
Constant	5.375 [0.871]	2.810 [1.185]		5.496 [1.405]
Distress_{i0}				0.261 [0.013]
σ_η	1.539 [0.033]			1.056 [0.037]
σ_ϵ	2.106 [0.014]			2.115 [0.016]
$\hat{\rho}$	0.348 [0.010]			0.200 [0.012]
Childhood events				
Illness	0.123 [0.098]	0.057 [0.078]		0.036 [0.077]
Parent divorce	-0.382 [0.131]	-0.276 [0.102]		-0.409 [0.104]
Parent unemp	0.130 [0.111]	0.050 [0.099]		0.030 [0.088]
Trauma	0.885 [0.103]	0.498 [0.088]		0.466 [0.082]
Sent away	1.449 [0.242]	0.923 [0.285]		0.934 [0.193]
Parent addict	0.531 [0.117]	0.289 [0.094]		0.248 [0.094]
Phys. abuse	0.292 [0.171]	0.093 [0.150]		-0.016 [0.136]
n	1805		1805	1805
nT	12635	10830	9025	10830

[1] Standard errors are in parentheses. [2] Time dummies and means of time-varying regressors have been suppressed. [3] Hausman test of random versus fixed effects: $p = 0.000$. [4] Sargan test of over-identifying restrictions: $\chi^2(14)$,$p = 0.000$. [5] Arellano-Bond test of average autocovariance in residuals of order 1 is 0: $p = 0.000$. Arellano-Bond test that the average covariance in residuals of order 2 is 0: $p = 0.044$.

mental health.

Age has no clear effect on mental health for either gender. None of the non-linear terms are significant in any of the specifications and the level is significant only in the CMLE specification and for women in the MLE model.[18] We may tend to believe that mental health outcomes would deteriorate with age but since the dependent variable is a measure of psychological distress as we age, mortgages and children may no longer be major sources of stress.

The connection between mental health and household composition is weak. The estimates in Tables 5 and 6 show that although the coefficients for men and women have the same signs, their level of statistical significance varies. A greater number of young children in a household improves mental health for women in most of the specifications. Daily physical exercise is shown to improve mental health but it is not significant in the two latter (and more robust) specifications.

Both employment and marital status have significant negative effects on mental health. Unemployment has a clear and significant negative impact on mental health for both men and women.[19] Individuals who have never been married have lower mental health than the baseline category of being married or living with a partner. The effect of being divorced or separated is greater for women than for men.[20] The effect of being widowed although it appears to be stronger for men is not conclusive across the genders.

Educational attainment above the baseline category of less than high school has no clear relationship with mental health status for both men and women.

Incorporating time-invariant individual effects into the model is important: according to the variance component estimates 35% of unobserved variability is accounted for by individual heterogeneity for men and 38% for women.[21] The variance component terms are

[18] Hauck and Rice (2004) found age to be significant in both levels and non-linear terms in all specifications except GMM IV.

[19] One potential problem with unemployment and mental health status is that there could be reverse causality between them as changes in current mental health could alter an individual's employment status.

[20] Hauck and Rice (2004) found that the relationship was the opposite for divorce/separation.

[21] The error-component mobility estimates were slightly higher using the unbalanced panel. The mobility

Table 6 – Mental health status mobility using NPHS balanced panel: Women

	MLE (1)	OLS (2)	GMM IV (3) 1st diff	CMLE (4)
$\text{Distress}_{i,t-1}$		0.430 [0.017]	0.045 [0.025]	0.125 [0.010]
Income	-0.137 [0.038]	-0.220 [0.068]	0.094 [0.099]	0.060 [0.045]
Perm income				-0.550 [0.086]
Age	-0.101 [0.049]	-0.010 [0.068]		0.306 [0.126]
Age^2	0.149 [0.102]	0.013 [0.135]	0.137 [0.086]	0.080 [0.150]
Age^3	-0.087 [0.067]	-0.018 [0.085]	-0.043 [0.065]	-0.033 [0.098]
HH size	-0.021 [0.028]	-0.046 [0.043]	0.100 [0.071]	0.019 [0.038]
No.Child 05	-0.195 [0.048]	-0.203 [0.071]	-0.091 [0.119]	-0.114 [0.060]
No.Child 611	-0.131 [0.042]	-0.070 [0.072]	-0.147 [0.106]	-0.025 [0.051]
Unemployed	0.551 [0.115]	0.561 [0.188]	0.515 [0.218]	0.585 [0.130]
Never married	0.460 [0.091]	0.269 [0.136]	0.605 [0.219]	0.293 [0.099]
Divorced/separated	0.695 [0.085]	0.346 [0.117]	0.978 [0.214]	0.433 [0.089]
Widowed	0.157 [0.097]	0.020 [0.119]	0.166 [0.246]	-0.012 [0.101]
High school	-0.053 [0.110]	0.095 [0.114]		0.022 [0.096]
Degree	-0.160 [0.073]	0.029 [0.074]		0.078 [0.070]
Rural	-0.057 [0.070]	-0.085 [0.074]		-0.102 [0.070]
Daily exercise	-0.184 [0.049]	-0.310 [0.066]	-0.008 [0.083]	-0.096 [0.057]
Constant	6.584 [0.829]	3.537 [1.204]		7.070 [1.451]
Distress_{i0}				0.260 [0.011]
σ_η	1.916 [0.034]			1.374 [0.036]
σ_ϵ	2.467 [0.014]			2.454 [0.016]
$\hat{\rho}$	0.376 [0.009]			0.239 [0.010]
Childhood events				
Illness	0.463 [0.107]	0.204 [0.085]		0.132 [0.087]
Parent divorce	0.219 [0.125]	0.191 [0.109]		0.318 [0.100]
Parent unemp	0.549 [0.115]	0.282 [0.100]		0.262 [0.092]
Trauma	0.867 [0.097]	0.473 [0.077]		0.441 [0.079]
Sent away	1.373 [0.250]	0.900 [0.370]		1.143 [0.200]
Parent addict	0.001 [0.107]	-0.041 [0.101]		-0.094 [0.086]
Phys. abuse	0.267 [0.129]	0.094 [0.111]		0.019 [0.103]
n	2550		2550	2550
nT	17850	15300	12750	15300

[1] Standard errors are in parentheses. [2] Time dummies and means of time-varying regressors have been suppressed. [3] Hausman test of random versus fixed effects: $p = 0.138$. [4] Sargan test of over-identifying restrictions: $\chi^2(14)$,$p = 0.000$. [5] Arellano-Bond test of average autocovariance in residuals of order 1 is 0: $p = 0.000$. Arellano-Bond test that the average covariance in residuals of order 2 is 0: $p = 0.433$.

significant but their magnitude implies that mobility in mental health status is high and it is primarily dominated by time-varying random disturbances. Mental health mobility is slightly higher for men than for women.[22]

The OLS, GMM IV, and CMLE models provide estimates of the state dependence of mental health status by including a lagged dependent variable. As suggested in the methodology section the OLS estimates of λ are the highest for both men and women. For men, the coefficient is 0.405 and for women is it 0.430.[23] While both of these coefficients are significant they are less than unity which would imply complete persistence. The coefficient has a similar magnitude to the marital status variables. I therefore conclude that these results favour mobility in mental health.

The first difference estimate of state dependence in column (3) of Tables 5 and 6, suggests even greater mobility. For men the coefficient is 0.066 and for women it is 0.045.[24] The coefficient is more significant for men; part of the reduced magnitude of the state dependence coefficients may be explained by the IV procedure if the lagged levels are poor instruments for the first differences (Arellano and Bond, 1991). Hauck and Rice (2004) state that the quality of instruments can be measured by comparing the GMM IV coefficient on lagged mental health to the one obtained from the within-groups estimator of equation (5). As shown in Tables 5 and 6, both GMM IV models failed the Sargan test for over-identifying restrictions. This suggests that it may be overly restrictive to use the multiple moment condition.[25] According to the Arellano-Bond tests for autocorrelation of the residuals in first-difference form, the equation for women did not have evidence of second-order serial correlation; for men there was only evidence at the 5 and 10 percent levels.[26] After eliminating individual

estimate for men is 38% and for women it is 41%. These estimates are provided in Tables A.3 and A.4.

[22]Hauck and Rice (2004) demonstrates that in the BPHS this relationship is reversed.

[23]The unbalanced panel state dependence estimates are 0.406 and 0.437 for men and women respectively.

[24]For the unbalanced panel, these estimates are 0.049 for men and 0.037 for women.

[25]Most applied studies fail to meet this test. There was evidence to reject the null hypothesis in Hauck and Rice (2004) for women but not for men. In the unbalanced NPHS panel, the GMM IV model did not fail the Sargan test for men.

[26]In the unbalanced panel GMM IV model, there was not sufficient evidence of second-order serial correlation for men.

effects from the model, I observe higher mobility for both men and women according to the state dependence parameter.

The CMLE model allows us to separate mobility into two categories: mobility due to state dependence and mobility due to unobserved heterogeneity. The estimates of state dependence are similar for both genders with men at 0.134 and women at 0.125. These estimates are greater than those suggested by the GMM IV. By contrast, the fraction of the variance due to the unobserved individual effects is 20 percent for men and 24 percent for women: this represents a 42 percent reduction for men and a 37 percent reduction for women in the estimates obtained from the variance component MLE model. I also determine that the initial health observation has a larger effect on current mental health than the state dependence estimate in the CMLE model (0.261 for men, and 0.260 for women).[27] This implies that initial mental health is a greater determinant of current mental health than the individual's state of mental health in the previous period. Overall, I find that mobility in mental health across time is strongly supported by both the state dependence and unobserved heterogeneity mobility estimates in the CMLE model.[28] Using a balanced panel to estimate mobility tends to underestimate the measures of mobility when compared to unbalanced panel estimates. However the parameter estimates for the covariates are similar. This evidence leads me to conclude that there is mobility in mental health outcomes in Canada and that women experience marginally less mobility than men.

7.2 Adverse childhood experiences and adult mental health

The second focus of the above empirical models is to determine the relationship between adverse childhood experiences and adult mental health outcomes. I provide the estimates for the effect of seven childhood events on adult mental health in Tables 5 and 6. Childhood experiences have significant statistical and economical impacts on current mental health.

[27] Hauck and Rice (2004) estimated a similar coefficient.

[28] The results from the analysis of the unbalanced NPHS panel CMLE model also support this claim. In addition, initial mental health status has a higher magnitude for both men and women.

One example of an adverse childhood experience is an extended stay in the hospital: this type of event has a clear negative impact on mental health for women. This same experience may have the same sign for men but it is not a significant factor in mental health. The experience of parental divorce as a child has opposing effects on mental health for men and women alike. There is an observed improvement in adult mental health of men but a degradation for women.[29] If an individual had one parent who was involuntarily unemployed for an extended period of time then he or she will tend to have lower mental health as an adult; this relationship is statistically significant for women but not for men.

Childhood events which damage the relationship between child and adult appear to be the most significant in my models. Both men and women who experience a traumatic event as a child have worse mental health as adults; this effect remains strong even after controlling for both lagged mental health status and the initial mental health score. Being sent away from home as a child or teen as punishment for misbehavior is the most significant economic factor of any of the covariates; this is true for both men and women. Men are shown to have lower mental health if one of their parents abused drugs or alcohol during their childhood. For women, this relationship is not supported.[30] Both men and women who were victims of physical abuse as children have worse mental health as adults. However the effect of physical abuse becomes insignificant when the lagged dependent variable is included in the model. It can therefore be concluded that physical abuse worsens adult mental health but this is manifested as a one time shock rather than a continuous negative impact on mental health status after controlling for past history.[31] These results demonstrate that adverse childhood experiences can have strong and continuing negative impacts on adult mental health in Canada. When we consider the economic significance of these variables, a large

[29] In the unbalanced panel, parental divorce is not a significant determinant of current mental health status.

[30] After controlling for lagged mental health status in the unbalanced panel, the statistical significance of parent addiction dissipated in the male sample. The impact of this is likely captured by past history of the regressors and it does not have a new and continuous effect on current mental health.

[31] In the unbalanced panel, the economic significance of physical abuse is much higher and the effect persists even after both the lagged dependent variable and initial mental health score are included as regressors. For men, being physically abused as a child corresponds to an increase in the K6 scale by 1.02 points. Given the mean distress in the unbalanced panel is 2.37, this is a dramatic increase.

portion of the difference in average mental health status for men and women in the sample can be explained by exposure to adverse childhood experiences. In general, women are more likely to experience both physical abuse and a traumatic experience as a child.

7.3 Mobility across sub-samples

Tables 7 and 8 present a summary of the estimates of mobility for men and women across various sub-samples. Column (1) presents the variance component estimate from the MLE specification. This is followed by the state dependence parameter as measured in the OLS dynamic panel model as well as GMM IV in first differences. Column (4) summarizes the parameter estimates obtained from the CMLE model that partitions mobility into the state dependence and the proportion of the variance accounted for by unobserved heterogeneity. The effect of initial mental health status on current mental health is also provided.

The MLE and OLS measures of mobility show that there is substantial mobility for individuals with poor mental health. The state dependence parameter also supports high mobility for both men and women in this category. While there is no definitive gradient across the income quintiles, men in the lowest income quintile experience the least mobility. For women, the lowest income quintile has the 2nd lowest mobility.[32] The evidence across age cohorts suggests there is a general trend of lower mobility in the higher age quintiles; for women this pattern does not seem to be evident.[33] As for educational attainment, individuals with either no high school or a high school diploma have higher mobility according to both parameters but the difference is marginal.

The results from columns (3) and (4) suggest that there are no clear gradients for men or women; this is true for state dependence and the proportion of the variance attributable to unobserved heterogeneity. Although deviations between the groups are smaller in the GMM IV and CMLE specifications, some of the patterns oppose the estimates obtained by the MLE

[32]This relationship is supported by the unbalanced panel subsample results. The unbalanced panel estimates are provided in Tables A.7 and A.8.

[33]The decrease in mobility is more evident at higher age quintiles in the unbalanced panel for men and women alike.

Table 7 – Sub-sample results using NPHS balanced panel: Men

	MLE	OLS	GMM IV 1st diff	CMLE		
	(1)	(2)	(3)	(4)		
	$\hat{\rho}$	$\hat{\lambda}$	$\hat{\lambda}$	$\hat{\lambda}$	$\hat{\alpha}_1$	$\hat{\rho}$
All data	0.348 [0.010]	0.405 [0.017]	0.066 [0.026]	0.134 [0.012]	0.261 [0.013]	0.200 [0.012]
Health						
Unhealthy	0.075 [0.008]	0.127 [0.016]	0.063 [0.022]	0.080 [0.014]	0.040 [0.011]	0.043 [0.010]
Healthy	0.182 [0.016]	0.272 [0.025]	0.111 [0.034]	0.156 [0.021]	0.113 [0.022]	0.092 [0.018]
Income						
1st quintile	0.508 [0.028]	0.515 [0.036]	-0.085 [0.048]†	0.131 [0.035]	0.404 [0.035]	0.187 [0.034]
2nd quintile	0.282 [0.021]	0.382 [0.031]	0.154 [0.039]	0.190 [0.026]	0.178 [0.028]	0.141 [0.024]
3rd quintile	0.299 [0.023]	0.342 [0.033]	0.070 [0.040]	0.107 [0.026]	0.207 [0.028]	0.188 [0.026]
4th quintile	0.397 [0.025]	0.432 [0.041]	0.144 [0.046]‡	0.096 [0.028]	0.321 [0.035]	0.236 [0.029]
5th quintile	0.383 [0.022]	0.419 [0.036]	-0.025 [0.035]	0.117 [0.023]	0.255 [0.025]	0.232 [0.024]
Age						
1st quintile	0.345 [0.027]	0.392 [0.041]	0.023 [0.040]	0.110 [0.030]	0.198 [0.037]	0.231 [0.031]
2nd quintile	0.321 [0.019]	0.363 [0.028]	0.033 [0.038]	0.113 [0.021]	0.193 [0.022]	0.193 [0.022]
3rd quintile	0.420 [0.021]	0.467 [0.030]	0.117 [0.041]	0.141 [0.024]	0.397 [0.029]	0.188 [0.024]
4th quintile	0.419 [0.023]	0.478 [0.037]	-0.007 [0.049]	0.177 [0.027]	0.336 [0.029]	0.172 [0.026]
5th quintile	0.424 [0.040]	0.432 [0.074]	-0.181 [0.058]	0.104 [0.042]	0.354 [0.043]	0.156 [0.040]
Education						
$\leq$ High school	0.357 [0.018]	0.417 [0.032]	0.066 [0.041]	0.160 [0.021]	0.261 [0.022]	0.160 [0.020]
Degree	0.379 [0.017]	0.431 [0.027]	0.058 [0.036]	0.131 [0.018]	0.250 [0.021]	0.247 [0.020]

[1] Standard errors are in parentheses. [2] All GMM IV models failed the Sargan test of over-identifying restrictions (at the 5% level) except ‡: $p = 0.071$. [3] All GMM IV models passed tests for autocorrelation of order 2 except †: $p = 0.047$.
[4] Individuals are classified as being unhealthy if they were above the sample mean of the distress index and are classified as healthy if their time-average was below the sample mean.

and OLS. For men in particular, the gradients as measured by $\hat{\rho}$ for both age and income are contrary to the MLE and OLS specifications.[34] As measured by $\hat{\rho}$, mobility across the education categories is more evident in the CMLE model. Men with post-secondary degrees have lower mobility but for women, this gradient goes in the opposite direction and is larger. The estimates for initial health status, $\hat{\alpha}_1$, indicate that initial mental health importance does vary across sub-populations; this is especially true for men. $\hat{\alpha}_1$ is higher for men with low income and lacking a post-secondary degree. Furthermore, initial mental health is a more important determinant of current mental health status in the higher age quintiles.

[34] In the unbalanced panel, decreasing mobility across age quintiles is still present in the CMLE specification.

Table 8 – Sub-sample results using NPHS balanced panel: Women

	MLE	OLS	GMM IV 1st diff	CMLE		
	(1)	(2)	(3)	(4)		
	$\hat{\rho}$	$\hat{\lambda}$	$\hat{\lambda}$	$\hat{\lambda}$	$\hat{\alpha}_1$	$\hat{\rho}$
All data	0.376 [0.009]	0.430 [0.017]	0.045 [0.025]	0.125 [0.010]	0.260 [0.011]	0.239 [0.010]
Health						
Unhealthy	0.105 [0.008]	0.148 [0.013]	0.048 [0.019]‡	0.074 [0.012]	0.069 [0.010]	0.064 [0.009]
Healthy	0.177 [0.013]	0.260 [0.024]	0.068 [0.031]	0.135 [0.017]	0.077 [0.017]	0.118 [0.015]
Income						
1st quintile	0.410 [0.021]	0.434 [0.031]	0.066 [0.041]	0.115 [0.023]	0.265 [0.025]	0.231 [0.024]
2nd quintile	0.390 [0.018]	0.409 [0.037]	0.047 [0.036]	0.070 [0.020]	0.335 [0.024]	0.239 [0.022]
3rd quintile	0.401 [0.020]	0.493 [0.046]	0.033 [0.038]	0.380 [0.017]	0.155 [0.020]	0.037 [0.001]
4th quintile	0.435 [0.021]	0.500 [0.033]	0.021 [0.054]	0.151 [0.023]	0.285 [0.028]	0.272 [0.025]
5th quintile	0.357 [0.020]	0.393 [0.033]	0.075 [0.044]	0.101 [0.022]	0.279 [0.024]	0.206 [0.023]
Age						
1st quintile	0.363 [0.021]	0.412 [0.032]	0.056 [0.048]	0.156 [0.024]	0.220 [0.023]	0.161 [0.023]
2nd quintile	0.410 [0.016]	0.451 [0.031]	0.011 [0.039]	0.105 [0.018]	0.297 [0.024]	0.287 [0.020]
3rd quintile	0.439 [0.019]	0.490 [0.045]	0.003 [0.038]	0.141 [0.022]	0.349 [0.023]	0.216 [0.022]
4th quintile	0.419 [0.020]	0.464 [0.036]	0.022 [0.034]	0.301 [0.018]	0.205 [0.019]	0.043 [0.001]
5th quintile	0.377 [0.030]	0.411 [0.037]	0.091 [0.038]	0.145 [0.031]	0.229 [0.028]	0.176 [0.032]
Education						
$\leq$ High school	0.378 [0.015]	0.417 [0.032]	-0.003 [0.038]	0.073 [0.017]	0.281 [0.022]	0.286 [0.019]
Degree	0.413 [0.014]	0.477 [0.029]	0.091 [0.034]	0.342 [0.013]	0.191 [0.013]	0.036 [0.001]

[1] Standard errors are in parentheses. [2] All GMM IV models failed the Sargan test of over-identifying restrictions (at the 5% level) except ‡: $p = 0.231$. [3] All GMM IV models passed tests for autocorrelation of order 2. [4] Individuals are classified as being unhealthy if they were above the sample mean of the distress index and are classified as healthy if their time-average was below the sample mean.

Initial mental health is a larger determinant for women with less education but there are no clear gradients in either the age or income quintiles.[35] The sub-sample analysis suggests there is some evidence of gradients using both measures of mobility but the relationships are not robust across model specifications. However the importance of initial mental health on current mental health does vary by socioeconomic group, especially for men.

[35]The magnitude of the coefficient on initial mental health status increases for women at higher age quintiles in the unbalanced panel.

8 Conclusion

A greater understanding of the underlying causes and risk-factors of mental health will not only help to destigmatize mental health problems in Canada, it will also allow us to better target treatment programs. As suggested in Hauck and Rice (2004) longitudinal data permits analysis of both the severity and persistence of mental health problems across different risk groups.

In this paper, I followed the applied econometric techniques proposed in Hauck and Rice (2004) to empirically estimate mental health mobility in Canada using data from the NPHS. I used the K6 distress scale index from the NPHS as a measure of mental health status; these measures are similar to the GHQ used in studies done with the BHPS and have been shown to be more effective in other studies. I used seven waves of the NPHS to estimate two different measures of mobility: the first was derived from a variance component model where I estimated the proportion of the variation explained by unobserved heterogeneity. The second measure of mobility was obtained by including a lagged dependent variable in the regressions. I also analyzed the impact of adverse childhood experiences on current adult mental health outcomes. These events are of particular interest because they represent potentially exogenous shocks to adult mental health.

I found evidence of high mobility in mental health status for both men and women. I also determined that adverse experiences during childhood have a dramatic impact on adult mental health. Further studies on the determinants of mental health should expand the number of adverse experiences according to the list detailed in Felitti and Anda (2009). The sub-sample analysis found that systematic differences in mobility across socioeconomic groups were unclear but there was some indication that the proportion of the variance due to unobserved heterogeneity varied across groups. Moreover, the effect of initial mental health status differed more widely across socioeconomic categories. This suggests that differences in severity and persistence of mental health may be connected to initial inequality between socioeconomic groups. From a policy point of view, it is important to identify how interven-

tions could correct for those initial differences because in general, mobility across the groups is similar.

Further analysis of mental health mobility in Canada should focus on confirming whether the estimates obtained here are robust; this can be executed by testing other models that allow for correlated effects between the individual effect and regressors. My results have led me to the conclusion that more investigation needs to be undertaken to confirm whether mental health-related attrition and non-response bias alter the mobility estimates obtained using the NPHS. These steps would help to confirm the reliability of the econometric techniques suggested in Hauck and Rice (2004) when applied to Canadian data and would also lead to a deeper understanding of mental health mobility in Canada.

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A Appendix

Table A.1 – NPHS variable definitions

Distress	NPHS distress scale (index from 0 to 24); measures interviewer-administered questionnaire on level of psychological distress (higher score = more distress)
$\text{Distress}_{i,t-1}$	Lagged NPHS distress scale
Distress_{i0}	an individual's NPHS distress scale score at wave 1
Income	logarithm of real per capita household income; constructed from household income
Permanent income	Average income across all waves of the survey that a household was present
Age	Age in years at current wave
HH size	Number of people in a household
No.Child 05	Number of children in household aged 0-5
No.Child 611	Number of children in household aged 6-11
Daily exercise	1 if respondent engages in daily physical exercise ($>$ 15 minutes), 0 otherwise
Unemployed	1 if unemployed, 0 otherwise
Never married	1 if never married, 0 otherwise
Divorced/separated	1 if divorced or separated, 0 otherwise
Widowed	1 if widowed, 0 otherwise
Rural	1 if household is in a rural census area, 0 otherwise
High school	1 if highest academic qualification is high school, 0 otherwise
Degree	1 if highest academic qualification is a post-secondary degree, 0 otherwise
Childhood events	
Illness	1 if individual spent more than 2 weeks in a hospital as a child or teenager, 0 otherwise
Parent divorce	1 if respondent's parents divorced while they were still a child or teenager, 0 otherwise
Parent unemp	1 if respondent's mother or father was unemployed for a long time when they wanted to be working, 0 otherwise
Trauma	1 if something scared the respondent as a child or teenager enough that they thought about it for years afterward, 0 otherwise
Sent away	1 if the respondent was sent away from home for doing something wrong as a child or teenager, 0 otherwise
Parent addict	1 if either of the respondent's parents abused drugs or alcohol often that it caused problems in the household, 0 otherwise
Phys. abuse	1 if respondent was physically abused as a child or teenager by someone close to them, 0 otherwise

Table A.2 – Transition matrices for NPHS unbalanced panel

DISTRESS quartile	1	2	3	4	N
(a) *Men*					
1	0.615	0.133	0.154	0.098	7566
2	0.448	0.180	0.232	0.140	2937
3	0.316	0.165	0.295	0.223	4793
4	0.194	0.092	0.252	0.462	4946
N	8442	2785	4504	4511	20242
(b) *Women*					
1	0.546	0.274	0.103	0.077	7647
2	0.324	0.372	0.180	0.124	8028
3	0.204	0.327	0.241	0.228	5028
4	0.124	0.188	0.202	0.486	6203
N	8578	7886	4693	5749	26906

[1] The unbalanced panel uses all information available for individuals who were present in the first wave.
[2] Transition probabilities are unweighted.

Table A.3 – Mental health status mobility using NPHS unbalanced panel: Men

	MLE (1)	OLS (2)	GMM IV (3) 1st diff	CMLE (4)
$\text{Distress}_{i,t-1}$		0.406 [0.013]	0.049 [0.022]	0.108 [0.009]
Income	-0.143 [0.025]	-0.142 [0.039]	0.118 [0.056]	0.068 [0.033]
Perm income				-0.503 [0.059]
Age	-0.036 [0.032]	0.094 [0.043]		0.045 [0.059]
Age^2	0.002 [0.063]	-0.202 [0.083]	0.054 [0.066]	-0.059 [0.114]
Age^3	0.024 [0.040]	0.128 [0.051]	0.018 [0.056]	0.064 [0.073]
HH size	-0.034 [0.019]	-0.042 [0.029]	0.023 [0.059]	0.066 [0.027]
No.Child 05	-0.036 [0.037]	-0.059 [0.053]	-0.150 [0.105]	-0.048 [0.050]
No.Child 611	0.008 [0.034]	0.018 [0.053]	-0.077 [0.092]	0.027 [0.043]
Unemployed	0.481 [0.082]	0.494 [0.169]	0.348 [0.226]	0.384 [0.105]
Never married	0.465 [0.067]	0.337 [0.103]	0.578 [0.191]	0.295 [0.075]
Divorced/separated	0.550 [0.066]	0.513 [0.090]	0.532 [0.186]	0.438 [0.070]
Widowed	0.432 [0.095]	0.456 [0.134]	0.036 [0.255]	0.313 [0.101]
High school	-0.223 [0.079]	-0.068 [0.073]		-0.086 [0.075]
Degree	-0.130 [0.054]	-0.018 [0.053]		0.018 [0.052]
Rural	-0.106 [0.050]	-0.107 [0.051]		-0.076 [0.052]
Daily exercise	-0.130 [0.036]	-0.123 [0.049]	0.034 [0.070]	-0.038 [0.044]
Constant	5.331 [0.550]	1.140 [0.748]		3.485 [0.828]
Distress_{i0}				0.270 [0.010]
σ_η	1.782 [0.024]			1.300 [0.031]
σ_ϵ	2.278 [0.011]			2.231 [0.013]
$\hat{\rho}$	0.380 [0.007]			0.253 [0.010]
Childhood events				
Illness	0.027 [0.070]	0.012 [0.057]		-0.030 [0.060]
Parent divorce	-0.061 [0.092]	-0.106 [0.077]		-0.096 [0.080]
Parent unemp	0.210 [0.079]	0.075 [0.075]		0.070 [0.068]
Trauma	0.919 [0.071]	0.454 [0.065]		0.395 [0.063]
Sent away	0.833 [0.168]	0.440 [0.182]		0.471 [0.148]
Parent addict	0.284 [0.082]	0.133 [0.072]		0.099 [0.071]
Phys. abuse	1.019 [0.124]	0.529 [0.131]		0.537 [0.107]
n	5675		4416	5124
nT	27628	21291	15354	21291

[1] Standard errors are in parentheses. [2] Time dummies and means of time-varying regressors have been suppressed. [3] Hausman test of random versus fixed effects: $p = 0.000$. [4] Sargan test of over-identifying restrictions: $\chi^2(14)$,$p = 0.451$. [5] Arellano-Bond test of average autocovariance in residuals of order 1 is 0: $p = 0.000$. Arellano-Bond test that the average covariance in residuals of order 2 is 0: $p = 0.425$.

Table A.4 – Mental health status mobility using NPHS unbalanced panel: Women

	MLE (1)	OLS (2)	GMM IV (3) 1st diff	CMLE (4)
$\text{Distress}_{i,t-1}$		0.437 [0.011]	0.037 [0.021]	0.118 [0.008]
Income	-0.252 [0.025]	-0.294 [0.042]	-0.003 [0.061]	-0.097 [0.033]
Perm income				-0.404 [0.059]
Age	-0.002 [0.032]	0.102 [0.041]		0.124 [0.058]
Age^2	-0.063 [0.063]	-0.215 [0.078]	0.125 [0.067]	-0.109 [0.109]
Age^3	0.065 [0.039]	0.133 [0.047]	-0.052 [0.052]	0.081 [0.069]
HH size	-0.050 [0.020]	-0.084 [0.030]	0.004 [0.057]	-0.034 [0.029]
No.Child 05	-0.180 [0.038]	-0.147 [0.053]	-0.060 [0.096]	-0.162 [0.050]
No.Child 611	-0.079 [0.033]	-0.030 [0.054]	-0.064 [0.089]	-0.014 [0.042]
Unemployed	0.323 [0.085]	0.311 [0.132]	0.130 [0.159]	0.233 [0.101]
Never married	0.485 [0.067]	0.233 [0.098]	0.456 [0.172]	0.312 [0.074]
Divorced/separated	0.651 [0.064]	0.304 [0.088]	0.662 [0.170]	0.417 [0.068]
Widowed	0.298 [0.065]	0.122 [0.085]	0.198 [0.184]	0.108 [0.071]
High school	0.080 [0.077]	0.130 [0.077]		0.161 [0.070]
Degree	-0.205 [0.055]	0.000 [0.052]		0.063 [0.053]
Rural	-0.013 [0.052]	-0.062 [0.052]		-0.034 [0.053]
Daily exercise	-0.207 [0.036]	-0.265 [0.049]	-0.006 [0.065]	-0.072 [0.044]
Constant	6.350 [0.548]	2.758 [0.761]		3.578 [0.820]
Distress_{i0}				0.285 [0.008]
σ_η	2.121 [0.025]			1.501 [0.029]
σ_ϵ	2.555 [0.011]			2.523 [0.013]
$\hat{\rho}$	0.408 [0.006]			0.261 [0.008]
Childhood events				
Illness	0.398 [0.076]	0.211 [0.062]		0.160 [0.064]
Parent divorce	0.052 [0.092]	0.084 [0.078]		0.155 [0.077]
Parent unemp	0.339 [0.082]	0.187 [0.072]		0.161 [0.069]
Trauma	0.838 [0.069]	0.344 [0.054]		0.313 [0.058]
Sent away	1.381 [0.180]	0.691 [0.199]		0.630 [0.154]
Parent Addict	0.152 [0.082]	0.034 [0.068]		0.027 [0.068]
Phys. abuse	0.789 [0.098]	0.338 [0.084]		0.405 [0.082]
n	7208		5772	6570
nT	36120	28417	20816	28417

[1] Standard errors are in parentheses. [2] Time dummies and means of time-varying regressors have been suppressed. [3] Hausman test of random versus fixed effects: $p = 0.000$. [4] Sargan test of over-identifying restrictions: $\chi^2(14)$,$p = 0.000$. [5] Arellano-Bond test of average autocovariance in residuals of order 1 is 0: $p = 0.000$. Arellano-Bond test that the average covariance in residuals of order 2 is 0: $p = 0.649$.

Table A.5 – Mental health status mobility using NPHS balanced panel and permanent income: Men

	MLE (1)	OLS (2)	GMM IV (3) 1st diff	CMLE (4)
$\text{Distress}_{i,t-1}$		0.405 [0.017]	0.066 [0.026]	0.134 [0.012]
Income	-0.084 [0.044]	-0.048 [0.077]	0.081 [0.067]	-0.021 [0.050]
Perm income	-0.222 [0.087]	-0.171 [0.106]		-0.179 [0.089]
Age	-0.053 [0.051]	-0.028 [0.067]		0.311 [0.110]
Age^2	0.022 [0.105]	0.035 [0.132]	0.174 [0.082]	-0.211 [0.157]
Age^3	0.010 [0.070]	-0.020 [0.082]	-0.093 [0.065]	0.149 [0.103]
HH size	-0.003 [0.026]	0.024 [0.043]	0.038 [0.065]	0.047 [0.034]
No.Child 05	-0.094 [0.048]	-0.101 [0.072]	-0.077 [0.119]	-0.060 [0.060]
No.Child 611	-0.040 [0.043]	-0.065 [0.062]	0.021 [0.106]	0.003 [0.053]
Unemployed	0.511 [0.118]	0.611 [0.273]	0.142 [0.330]	0.359 [0.140]
Never married	0.439 [0.093]	0.378 [0.150]	0.307 [0.208]	0.290 [0.100]
Divorced/separated	0.438 [0.091]	0.512 [0.131]	0.108 [0.238]	0.308 [0.092]
Widowed	0.292 [0.137]	0.289 [0.169]	0.083 [0.388]	0.242 [0.137]
High school	-0.017 [0.114]	-0.008 [0.097]		-0.022 [0.098]
Degree	0.028 [0.076]	0.051 [0.072]		0.008 [0.068]
Rural	-0.169 [0.068]	-0.172 [0.067]		-0.135 [0.067]
Daily exercise	-0.126 [0.049]	-0.178 [0.066]	-0.075 [0.094]	-0.103 [0.058]
Constant	7.097 [1.101]	3.532 [1.279]		5.496 [1.405]
Distress_{i0}				0.261 [0.013]
σ_η	1.535 [0.033]			1.056 [0.037]
σ_ϵ	2.106 [0.014]			2.115 [0.016]
$\hat{\rho}$	0.347 [0.010]			0.200 [0.012]
Childhood events				
Illness	0.107 [0.098]	0.050 [0.078]		0.036 [0.077]
Parent divorce	-0.376 [0.131]	-0.273 [0.102]		-0.409 [0.104]
Parent unemp	0.117 [0.111]	0.046 [0.100]		0.030 [0.088]
Trauma	0.879 [0.103]	0.496 [0.088]		0.466 [0.082]
Sent away	1.410 [0.242]	0.906 [0.287]		0.934 [0.193]
Parent addict	0.541 [0.117]	0.294 [0.095]		0.248 [0.094]
Phys. abuse	0.270 [0.171]	0.085 [0.149]		-0.016 [0.136]
n	1805		1805	1805
nT	12635	10830	9025	10830

[1] Standard errors are in parentheses. [2] Time dummies and means of time-varying regressors have been suppressed. [3] Hausman test of random versus fixed effects: $p = 0.000$. [4] Sargan test of over-identifying restrictions: $\chi^2(14)$,$p = 0.000$. [5] Arellano-Bond test of average autocovariance in residuals of order 1 is 0: $p = 0.000$. Arellano-Bond test that the average covariance in residuals of order 2 is 0: $p = 0.044$.

Table A.6 – Mental health status mobility using NPHS balanced panel and permanent income: Women

	MLE (1)	OLS (2)	GMM IV (3) 1st diff	CMLE (4)
$\text{Distress}_{i,t-1}$		0.425 [0.018]	0.045 [0.025]	0.125 [0.010]
Income	-0.010 [0.041]	0.036 [0.084]	0.094 [0.099]	0.060 [0.045]
Perm income	-0.713 [0.088]	-0.496 [0.106]		-0.550 [0.086]
Age	-0.092 [0.049]	0.010 [0.068]		0.306 [0.126]
Age^2	0.140 [0.102]	-0.019 [0.135]	0.137 [0.086]	0.080 [0.150]
Age^3	-0.085 [0.067]	-0.002 [0.085]	-0.043 [0.065]	-0.033 [0.098]
HH size	-0.038 [0.028]	-0.069 [0.043]	0.100 [0.071]	0.019 [0.038]
No.Child 05	-0.204 [0.048]	-0.192 [0.071]	-0.091 [0.119]	-0.114 [0.060]
No.Child 611	-0.153 [0.042]	-0.097 [0.071]	-0.147 [0.106]	-0.025 [0.051]
Unemployed	0.537 [0.114]	0.544 [0.187]	0.515 [0.218]	0.585 [0.130]
Never married	0.466 [0.091]	0.256 [0.135]	0.605 [0.219]	0.293 [0.099]
Divorced/separated	0.672 [0.085]	0.315 [0.115]	0.978 [0.214]	0.433 [0.089]
Widowed	0.115 [0.097]	-0.036 [0.118]	0.166 [0.246]	-0.012 [0.101]
High school	-0.079 [0.109]	0.098 [0.114]		0.022 [0.096]
Degree	-0.065 [0.074]	0.092 [0.073]		0.078 [0.070]
Rural	-0.088 [0.070]	-0.113 [0.074]		-0.102 [0.070]
Daily exercise	-0.170 [0.049]	-0.290 [0.067]	-0.008 [0.083]	-0.096 [0.057]
Constant	12.104 [1.070]	5.615 [1.222]		7.070 [1.451]
Distress_{i0}				0.260 [0.011]
σ_η	1.890 [0.033]			1.374 [0.036]
σ_ϵ	2.467 [0.014]			2.454 [0.016]
$\hat{\rho}$	0.370 [0.009]			0.239 [0.010]
Childhood events				
Illness	0.432 [0.106]	0.191 [0.084]		0.132 [0.087]
Parent divorce	0.163 [0.124]	0.174 [0.109]		0.318 [0.100]
Parent unemp	0.497 [0.114]	0.265 [0.100]		0.262 [0.092]
Trauma	0.814 [0.096]	0.458 [0.077]		0.441 [0.079]
Sent away	1.301 [0.247]	0.884 [0.371]		1.143 [0.200]
Parent addict	0.030 [0.106]	-0.033 [0.101]		-0.094 [0.086]
Phys. abuse	0.262 [0.127]	0.094 [0.111]		0.019 [0.103]
n	2550		2550	2550
nT	17850	15300	12750	15300

[1] Standard errors are in parentheses. [2] Time dummies and means of time-varying regressors have been suppressed. [3] Hausman test of random versus fixed effects: $p = 0.138$. [4] Sargan test of over-identifying restrictions: $\chi^2(14)$,$p = 0.000$. [5] Arellano-Bond test of average autocovariance in residuals of order 1 is 0: $p = 0.000$. Arellano-Bond test that the average covariance in residuals of order 2 is 0: $p = 0.433$.

Table A.7 – Sub-sample results using NPHS unbalanced panel: Men

	MLE	OLS	GMM IV 1st diff	CMLE		
	(1)	(2)	(3)	(4)		
	$\hat{\rho}$	$\hat{\lambda}$	$\hat{\lambda}$	$\hat{\lambda}$	$\hat{\alpha}_1$	$\hat{\rho}$
All data	0.380 [0.007]	0.406 [0.013]	0.049 [0.022]	0.108 [0.009]	0.270 [0.010]	0.253 [0.010]
Health						
Unhealthy	0.057 [0.006]	0.102 [0.011]	0.049 [0.016]	0.057 [0.010]	0.026 [0.008]	0.050 [0.008]
Healthy	0.171 [0.010]	0.242 [0.020]	0.048 [0.029]‡	0.125 [0.015]	0.087 [0.015]	0.108 [0.014]
Income						
1st quintile	0.451 [0.018]	0.469 [0.029]	0.068 [0.043]†	0.153 [0.024]	0.314 [0.024]	0.229 [0.028]
2nd quintile	0.343 [0.014]	0.391 [0.023]	0.081 [0.043]	0.133 [0.020]	0.259 [0.021]	0.202 [0.020]
3rd quintile	0.389 [0.017]	0.392 [0.029]	0.015 [0.038]	0.099 [0.021]	0.287 [0.022]	0.237 [0.024]
4th quintile	0.452 [0.017]	0.513 [0.043]	0.139 [0.045]	0.127 [0.023]	0.339 [0.027]	0.312 [0.025]
5th quintile	0.355 [0.016]	0.362 [0.024]	-0.002 [0.035]	0.081 [0.019]	0.237 [0.020]	0.241 [0.021]
Age						
1st quintile	0.353 [0.018]	0.363 [0.029]	-0.007 [0.033]	0.105 [0.022]	0.242 [0.023]	0.202 [0.023]
2nd quintile	0.348 [0.015]	0.370 [0.023]	-0.004 [0.030]	0.082 [0.018]	0.236 [0.019]	0.263 [0.021]
3rd quintile	0.440 [0.015]	0.474 [0.031]	0.092 [0.045]	0.118 [0.020]	0.358 [0.023]	0.260 [0.022]
4th quintile	0.405 [0.016]	0.457 [0.027]	0.082 [0.049]	0.182 [0.021]	0.270 [0.020]	0.199 [0.022]
5th quintile	0.520 [0.018]	0.500 [0.048]	-0.045 [0.066]‡	0.058 [0.030]	0.438 [0.034]	0.348 [0.031]
Education						
$\leq$ High school	0.386 [0.012]	0.415 [0.021]	0.011 [0.031]	0.121 [0.016]	0.290 [0.016]	0.229 [0.017]
Degree	0.437 [0.012]	0.452 [0.028]	0.021 [0.038]‡	0.096 [0.015]	0.312 [0.018]	0.295 [0.017]

[1] Standard errors are in parentheses. [2] All GMM IV models failed the Sargan test of over-identifying restrictions (at the 5% level) except ‡: $p = 0.990$,$p = 0.059$,$p = 0.350$ [3] All GMM IV models passed tests for autocorrelation of order 2 except: †: $p = 0.043$,$p = 0.022$. [4] Individuals are classified as being unhealthy if they were above the sample mean of the distress index and are classified as healthy if their time-average was below the sample mean.

Table A.8 – Sub-sample results using NPHS unbalanced panel: Women

	MLE	OLS	GMM IV 1st diff	CMLE		
	(1)	(2)	(3)	(4)		
	$\hat{\rho}$	$\hat{\lambda}$	$\hat{\lambda}$	$\hat{\lambda}$	$\hat{\alpha}_1$	$\hat{\rho}$
All data	0.408 [0.006]	0.437 [0.011]	0.037 [0.021]	0.118 [0.008]	0.285 [0.008]	0.261 [0.008]
Health						
Unhealthy	0.081 [0.005]	0.122 [0.010]	0.044 [0.015]‡	0.062 [0.009]	0.042 [0.007]	0.061 [0.007]
Healthy	0.189 [0.009]	0.263 [0.016]	0.079 [0.028]	0.135 [0.013]	0.091 [0.012]	0.125 [0.012]
Income						
1st quintile	0.430 [0.014]	0.439 [0.022]	-0.027 [0.038]	0.121 [0.017]	0.289 [0.018]	0.249 [0.019]
2nd quintile	0.429 [0.012]	0.437 [0.023]	0.037 [0.032]	0.088 [0.016]	0.348 [0.017]	0.257 [0.017]
3rd quintile	0.421 [0.014]	0.473 [0.025]	0.018 [0.038]	0.133 [0.018]	0.290 [0.020]	0.295 [0.020]
4th quintile	0.431 [0.016]	0.484 [0.025]	0.055 [0.044]	0.159 [0.020]	0.282 [0.022]	0.258 [0.021]
5th quintile	0.396 [0.016]	0.421 [0.027]	0.082 [0.039]†	0.112 [0.019]	0.288 [0.021]	0.240 [0.021]
Age						
1st quintile	0.323 [0.015]	0.371 [0.027]	0.083 [0.042]	0.163 [0.019]	0.176 [0.018]	0.164 [0.019]
2nd quintile	0.434 [0.013]	0.451 [0.022]	-0.029 [0.031]	0.099 [0.015]	0.319 [0.018]	0.302 [0.017]
3rd quintile	0.464 [0.014]	0.486 [0.026]	-0.003 [0.039]	0.108 [0.018]	0.354 [0.020]	0.276 [0.020]
4th quintile	0.459 [0.014]	0.475 [0.023]	0.052 [0.037]	0.083 [0.018]	0.359 [0.020]	0.292 [0.019]
5th quintile	0.499 [0.015]	0.467 [0.026]	0.040 [0.041]	0.104 [0.020]	0.355 [0.021]	0.292 [0.023]
Education						
$\leq$ High school	0.420 [0.010]	0.441 [0.018]	0.007 [0.031]	0.100 [0.013]	0.308 [0.014]	0.279 [0.014]
Degree	0.456 [0.011]	0.481 [0.021]	0.059 [0.030]	0.138 [0.014]	0.323 [0.015]	0.266 [0.015]

[1] Standard errors are in parentheses.
[2] All GMM IV models failed the Sargan test of over-identifying restrictions (at the 5% level) except ‡: $p = 0.067$.
[3] All GMM IV models passed tests for autocorrelation of order 2 except: †: $p = 0.033$. [4] Individuals are classified as being unhealthy if they were above the sample mean of the distress index and are classified as healthy if their time-average was below the sample mean.