LIFE COURSE DETERMINANTS OF COGNITIVE PERFORMANCE AMONG OLDER WOMEN AND MEN IN ISMAILIA, EGYPT

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ABSTRACT

We evaluate the life course determinants of cognitive performance among 913 women and men ≥ 50 years in two districts in Ismailia, Egypt. Egypt is an excellent setting for this research, because girls' disadvantage in health and family care is well known, yet nothing is known about the consequences of such biases for cognitive functioning in later life. Four research questions motivate this analysis: (1) Do adverse childhood experiences, including low paternal/maternal schooling, low family economic status, ill health, and child marriage or labor have significant *net* effects on cognitive performance in later life?, (2) Do social, economic, and health-related conditions in middle adulthood modify the effects of childhood experiences on later-life cognitive performance?, (3) Does upward social mobility compensate for (or downward social mobility exacerbate) any adverse effects of childhood disadvantage?, and (4) Do the net and interactive effects of early-life disadvantage vary for women and men?

INTRODUCTION

The relationship between disadvantage at various stages of life and health in adulthood is complex and dynamic. Childhood may represent a "critical period" of human development that has lasting, independent effects on health in adulthood. Alternatively, experiences in childhood may operate through or interact with subsequent "turning points." To date, much of the life course research on social environment and health has focused on the effects of children's environment on health in (young) adulthood. Less work has focused on the relationships of either childhood or midlife experiences with health in later life, and remarkably little research in this area has differentiated the trajectories of women and men, even though their risks of illness, disability, and death differ in complex ways. Finally, much of the research on trajectories of health has focused on physical rather than cognitive conditions. This gap is surprising, given that severe cognitive impairments like Alzheimer's disease account for an estimated 2% of years lost due to disability worldwide, and this percentage should increase rapidly with the global aging of populations (World Health Organization 2001).

To fill these gaps in research, we evaluate the life course determinants of cognitive performance among 913 women and men aged 50 years and older in two districts in Ismailia, Egypt. Egypt is an excellent setting in which to undertake this research, because a disadvantage among girls in health and family care is well documented (Yount 1999, 2001, 2003a, 2003b, 2004), and virtually nothing is known about the consequences of such biases for either physical or cognitive functioning in later life. Thus, we will assess whether gendered adversity in early life has lasting effects on cognition in later life, and whether positive or negative turning points in middle adulthood modify any early-life effects for older women and men.

BACKGROUND

A growing body of evidence suggests that the relationship between disadvantage at various life stages and health in adulthood is complex and dynamic (Graham 2002). Scholars have proposed several conceptual models, including "critical period" models, "accumulation" models, and "pathway" models, to capture these temporal relationships (Figure 1).

[Insert Figure 1 here]

Critical period models suggest that the factors affecting disparities in health have their origins in exposures during specific periods of human development. Often, these models stress the ways in which exposure to deprivation in early life can have long-term effects on health, independent of the circumstances that arise in adulthood. Social scientists have shown, for example, that the socioeconomic environment to which children are exposed accounts for a substantial percentage of the association of adult socioeconomic status with self-rated health and reported chronic conditions (Van de Mheen et al. 1997; Power 1991; Lundberg 1991; Elo 1998; Gilman et al. 2002). Research on cognitive and psychosocial development has shown that insecurity and instability in early life, as measured for example by a lack of parental interest, divorce, or early parental loss, can affect cognitive function and psychosocial disorders into later life (Maughan and McCarthy 1997; Johnson and Barer 2002).[1] Also, an aged-adjusted index of socioeconomic status in childhood has been positively associated with cognitive performance among Finnish men aged 58–64 years (Turrell et al. 2002).[2]

In pathways models, early life is the initial stage in trajectories to adult health; yet, the effect of childhood is thought to be indirect, with poor social, economic, and health-related conditions in childhood affecting social trajectories into and through adulthood (Wadsworth 1997). A disadvantaged childhood, for example, may restrict educational opportunities, which in

turn influence an adult's socioeconomic circumstances and health-related behaviors. Such pathway effects have been traced through the lives of a 1946 national birth cohort study in Britain (Wadsworth and Kuh 1997), and scholars have recommended that models of cognitive performance be adjusted for morbidities that may mediate the effects of socioeconomic status on cognitive function in later life (Seeman 1996; Turrell et al. 2002).[3]

Finally, accumulation models (Dannefer 2003) suggest that exposure to advantage or disadvantage at various stages of life has cumulative effects on health, and evidence of such effects has been found in various studies (e.g., Mann et al. 1992; Power et al. 1999). Poor circumstances throughout life may confer the greatest risk of poor health in adulthood, but better circumstances at one stage may mitigate poor circumstances at another. Among Finnish men aged 58–64 years, for example, upward socioeconomic mobility has been positively associated with scores of cognitive performance, and downward socioeconomic mobility has been associated with lower scores (Turrell et al. 2002). Also, men who experienced the longest exposure to socioeconomic disadvantage recorded the worst cognitive scores, and those who enjoyed a high socioeconomic position at all major life stages had the highest cognitive performance (Turrell et al. 2002).

As implied above, these three models of the life course and health are not mutually exclusive (Graham 2002). For example, adversity in early life can direct children into developmental pathways that increase their risks of various disadvantages in adulthood, and these risks can expose individuals to additional cumulative effects. Second, all three models direct attention to what Graham (2002: 2008) calls "biographies of disadvantage." The emphasis of "critical periods" models on early life stresses the influences of parental biographies on health in adulthood. In pathways models, both childhood and adolescent-adult transitions are

considered key stages of life, whereas accumulation models stress the health effects of chronic disadvantage and the potential effects of "turning points" at any stage in the life course.

To date, much of the life course research on social environment and health has focused on the effects of children's environment on health in (young) adulthood. Less work has focused on the relationships of either childhood or midlife experiences with health in later life (Wadsworth 1997), and remarkably little research in this area has differentiated the trajectories of women and men (Luo and Waite (2005) are a recent exception.). Finally, much of the research on trajectories of health has focused on physical rather than cognitive conditions. This gap is surprising, given that severe cognitive impairments like Alzheimer's disease account for an estimated 2% of years lost due to disability worldwide, and this percentage should increase rapidly with the global aging of populations (World Health Organization 2001).

This paper fills important gaps in research by focusing on the life course determinants of cognitive performance among women and men aged 50 years and older in Ismailia, Egypt. Egypt is an especially good setting in which to undertake this research, because a disadvantage among girls in health and family care is well documented (Yount 1999, 2001, 2003a, 2003b, 2004), and virtually nothing is known about the potential consequences of such biases for health in later life. Thus, the models described above provide a useful framework in which to assess whether gendered adversity in early life has lasting effects on cognition in later-life, and whether positive or negative turning points in middle adulthood modify any early-life effects for older women and men. Four specific research questions motivate this analysis:

1. Do adverse experiences in childhood, including low paternal and material schooling, low family economic status, ill health, child marriage, or child labor have significant effects on cognitive performance in later life?

2. Do social, economic, and health-related conditions in middle adulthood modify the effects of these experiences in childhood on later-life cognitive performance?
3. Does upward social mobility compensate for (or does downward social mobility exacerbate) any adverse effects of childhood disadvantage on cognitive performance in later life?
4. To what extent do the net and interactive effects of early-life disadvantage on cognitive performance in later life vary for women and men?

THE SETTING

Egypt has a current (2005) population of nearly 78 million, and an annual rate of population growth of 1.8%. About 7.9 million Egyptians (10%) are over the age of 55, and about 16.5 million people (16%) are projected to be that age by 2025. Because women on average live longer than do men (74 vs. 69 years), a majority (54%) of Egyptians aged 55 years and older is women.[4] The most recent data reveal considerable disability in this group (Yount et al. 2004; Yount and Agree 2005; Yount and Khadr 2005), and morbidities that underlie both physical and cognitive impairments (e.g., obesity, diabetes, hypertension, ischemic heart disease) are widely prevalent (Aisha et al. 1993; Galal 2002; Herman et al. 1995; Ibrahim 1996; Ibrahim et al. 1995; Ibrahim et al. 2001). Because women tend to have higher levels of these risk factors and impairments, estimates of healthy life expectancy are lower for women than men (UNDP 2002). Thus, families increasingly include longer-lived adults with special needs for care (Sinunu, Yount, and El-Afify nd).

The specific setting for this study is Ismailia governorate, which is located in Lower (Northern) Egypt and houses approximately 844,000 residents (CAPMAS, 2004). Since 2001, virtually all households have had access to electricity, and a somewhat higher percentage of households in Ismailia than in all Lower Egypt has had access to piped water (93% vs. 90%). In

2000/2001, real the gross domestic product [GDP] per capita and rates of literacy among adults aged 15 years and older were higher in Ismailia than in all Lower Egypt (5,989 Egyptian pounds [LE] vs. LE 5,059; 73% vs. 65%). Although rates of literacy and participation in the labor force for women aged 15 and older have been higher in Ismailia than elsewhere in Lower Egypt (64% vs. 53%; 17% vs. 16%), these rates have achieved only 71% and 21% of similar rates for men. The governorate has had fewer physicians, nurses, beds, and health units per capita compared to all of Lower Egypt.[5]

SAMPLE AND DATA

The target sample for this study was 450 women and 450 men distributed evenly across the ages of 50–59, 60–69, and 70 years and older. A complete household census was conducted in one rural and one urban district in Ismailia governorate to generate the sampling frame for the study. Within groups of women and men, the following sampling fractions were used to select participants for the study: 1:1 for adults aged 70 years or older, 1:2 for adults aged 60–69 years, and 1:3 for adults aged 50–59 years. Based on this sampling frame, 1,182 age-eligible adults were invited to participate in the study. Of these 1,182, 1,053 (88%, including 491 men and 562 women) consented to participate and completed a baseline interview. The 470 men and 528 women who scored 10 or more points on a 20-point modified Mini Mental Status Exam [M-MMSE] participated in the interview on their own behalf. Seventeen of the 21 men and 30 of the 34 women who scored less than 10 on the M-MMSE were invited to identify a person living nearby who knew them well and who could respond on their behalf. For 4 men and 4 women who scored less than 10 on the M-MMSE, the field supervisor deemed them able to respond for themselves based on responses, from someone knowing the older adult well, to questions about the older adult's ability to care for himself or herself. Thus, 'respondent' refers to any self-

reporting older adult or any proxy who reported on an older person's behalf.

This analysis is based on data that were collected during the baseline interview of this study. In this interview, interviewers asked respondents to report on the following topics (among others): social and economic conditions during the first 15 years of life (self-rated economic situation of the family, residence, illnesses, confinement to bed for health-related reasons, and self-rated health); schooling, occupational, and marital history; date of diagnosis of acute and chronic illnesses (hypertension, diabetes, lung disease, heart disease, stroke, arthritis, osteoporosis, cancer, hearing, sight); risk behaviors (smoking), and illness-specific medical care.

The final analytic sample includes ever-married adults aged 50 years and older with complete baseline data on variables of interest. Of the 1,182 adults who were eligible for the baseline interview, the analytic sample excludes 129 non-participants in the baseline interview, 10 never-married participants, and 165 participants with item non-response for selected covariates, yielding an unweighted analytic sample of 878 (420 men, 458 women), or a weighted sample of 913 (466 men, 447 women).[6] Weights were calculated using the inverse of the sampling fractions so that the age-sex distribution of the sample for each district conformed to the distribution of the population aged 50 years and older in the district, by five-year age groups and sex, according to the most recent (1996) census.

The outcomes of interest in this analysis are self-rated memory at the time of interview (1 = poor – 5 = excellent), self-rated change in memory during the prior 12 months (1 = worse, 2 = same, 3 = better), as well as individual items and total scores for cognitive performance, which are based on a modified version of the Mini-Mental State Exam (M-MMSE). The MMSE has been used widely in clinical- and population-based research (Brayne and Calloway 1990; Escobar et al. 1986) to test for the presence of cognitive impairment and to screen for dementia

(O'Connor et al. 1991). The full test assesses orientation, registration, attention and calculation, recall, and language. A modified version of the MMSE has been used in other studies and tests similar domains of cognition (Palloni nd). Here, we operationalize responses to the M-MMSE in several ways: a summative score (0–20), an ordinal scale (0 = 0–10, 1 = 11–15, 2 = 16–20), dichotomous and ordinal scores for each of the items that comprise the M-MMSE, ordinal subscales based on standard definitions in the literature, and a dichotomous measure of cognitive performance where the cutpoint is the median score in the pooled sample of women and men. Measures of "disadvantage" during childhood C will capture events and environmental conditions during the period following birth to 15 years of age. Measures of socio-economic status during this period will include father's schooling (none, any), mother's schooling (none, any), whether lived ≥5 years in a rural residence during the first 15 years (yes, no), and self-rated family economic status relative to others before the respondent was age 15 years (very poor, poor, average, good, very good). Measures of illness and risk behaviors during childhood will include bed-confinement for at least one month during the first 15 years, self-rated health during the first 15 years (1 = poor to 5 = excellent), and reports of whether the respondent started smoking before age 15 years (no, yes). Reports of illnesses that occurred before age 15 years also will be considered (bilharizia, anemia, nephritis, hepatitis, measles, tuberculosis, rheumatic fever, asthma, chronic bronchitis, polio, mumps, meningitis, other); however, potential problems of poor knowledge and/or recall may limit their usefulness. Gender-specific measures of early childhood disadvantage will include child marriage (consummated marriage before age 15 years) for girls and child labor (worked for cash or kind before age 15 years) for boys.

Measures of socioeconomic circumstances during adulthood A will include the respondent's schooling attainment (none, primary, preparatory, secondary or more), the

respondent's occupational mobility (stable never worked, stable low (first work and work at 50 low status), upwardly mobile (first work lower status than work at age 50), downwardly mobile (first work higher status than work at age 50), exited (ever worked but not working at 50 years), and stable high (first work and work at age 50 high status), intergenerational mobility in schooling attainment (stable low (same-sex parent none, respondent none); upwardly mobile (same-sex parent none, respondent any); downwardly mobile (same-sex parent any; respondent none); stable high (same-sex parent any, respondent any). A score for social networks in adulthood will be derived from the first component of a principle components analysis of three items measuring the respondent's number of living children, duration of marriage, and number of household members 5 years before interview. Measures of illness in adulthood will include self-reports of those illnesses that are believed to be determinants of cognitive performance in later life. Available indicators include a history of specific morbidities (stroke, heart disease, diabetes), risk markers for these diseases (hypertension), and pharmacological agents (medications to control hypertension and cholesterol). (These measures will be included separately and simultaneously, using single indicators and composite indices).

Other potentially adverse events that measure social isolation in childhood or adulthood include whether the respondent's father died, whether the respondent's mother died, whether the respondent was ever divorced or separated, the number of sons of the respondent that died, and the number of daughters of the respondent that died. Finally, we will control for urban versus rural resident and household fixed effects to account for unmeasured characteristics of the household's environment that may be associated with cognitive performance in later life.

ANALYTIC STRATEGY

All analyses will be conducted separately for women and men to assess the extent to

which main and interactive effects vary by gender of the older adult. For the descriptive analysis, we will explore mean and median scores for self-rated memory at the time of interview, self-reported change in memory during the prior 12 months, and each item of the M-MMSE, for women and men overall by age group (50–59, 60–69, ≥70). Second, we will estimate mean and median scores for respondents' overall performance on the M-MMSE (0–20 point scale), as well as their performance on selected sub-scales, again for women and men overall and by age group. Sample weights will be used to adjust for the age-gender stratified sample design.

For the multivariate analysis, let Y_i be our measure of cognitive performance. Let C_i be a vector of experiences in childhood ($j = 1,\ldots,J$), and let S_i be a vector of gender-specific experiences in childhood ($k=1,\ldots,K$). Let A_i be a vector of experiences in adulthood that are believed to be associated with cognitive performance ($l = 1,\ldots,L$). Let, and let X_i be a vector of other controls, including household fixed effects to account for unobserved household-level factors that may be associated with cognitive performance ($m = 1,\ldots,M$). First, we will examine the unadjusted associations of childhood experiences and measures of cognitive performance. Then, we will assess the effects of C_i after adjusting for experiences in adulthood A_i. Finally, we will test interactions between C_i and A_i. Assuming that cognitive performance is measured continuously, the following series of equations will be estimated separately for women and men:

$$Y_i = \beta_0 + \sum_{j=1}^{J} \beta_j C_{i,j} + e_i \quad (1)$$

$$Y_i = \beta_0 + \sum_{j=1}^{J} \beta_j C_{i,j} + \sum_{k=1}^{K} \beta_k S_{i,k} + e_i \quad (2)$$

$$Y_i = \beta_0 + \sum_{j=1}^{J} \beta_j C_{i,j} + \sum_{l=1}^{L} \beta_l A_{i,l} + e_i \quad (3)$$

$$Y_i = \beta_0 + \sum_{j=1}^{J} \beta_j C_{i,j} + \sum_{l=1}^{L} \beta_l A_{i,l} + \sum_{m=1}^{M} \beta_m X_{i,m} + e_i \quad (4)$$

$$Y_i = \beta_0 + \sum_{j=1}^{J} \beta_j C_{i,j} + \sum_{k=1}^{K} \beta_k S_{i,k} + \sum_{l=1}^{L} \beta_l A_{i,l} + \sum_{m=1}^{M} \beta_m X_{i,m} + e_i \quad (5)$$

For ordinal and dichotomous measures of cognitive performance, ordinal logit and logit models will be estimated, respectively. Separate interactions of variables in C_i and S_i with those in A_i will provide tests of the interactive effects of child and adult experiences on cognitive performance in later life.

RESULTS

Appendix 1 shows the distributions of self-rated memory, reported changes in memory in the 12 months prior to interview, and mean scores on the MMSE, by the respondent's gender and age. Qualitatively, differences by gender in the distributions of these variables, overall and within age strata, are apparent and provide an empirical motivation for this analysis.

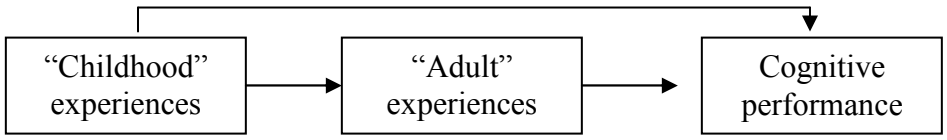
Appendix 1: Distributions of Self-Rated Memory and Reported Change in Memory During the Prior 12 months, and Mean Scores for the Modified Mini-Mental State Exam, Women and Men Aged 50 Years and Older, Two Districts in Ismailia, Egypt

	Women				Men				Total			
	50-59	60-69	≥70	Total	50-59	60-69	≥70	Total	50-59	60-69	≥70	Total
(*n* , weighted)	(241)	(142)	(64)	(447)	(232)	(158)	(76)	(466)	(473)	(300)	(140)	(913)
Self rated memory												
Excellent	8.8	6.5	1.7	7.0	16.3	15.6	6.8	14.5	12.4	11.2	4.5	10.8
Very good	72.0	58.3	51.3	64.7	72.5	71.7	62.6	70.6	72.3	65.4	57.4	67.8
Good	16.2	31.7	34.3	23.7	10.4	9.8	22.5	12.2	13.4	20.1	27.9	17.8
Fair	3.0	3.0	10.9	4.2	0.8	2.5	6.2	2.3	1.9	2.8	8.4	3.2
Poor	0.0	0.5	1.8	0.4	0.0	0.4	1.9	0.4	0.0	0.5	1.8	0.4
Changes in memory, prior 12 mos												
Better	8.6	7.9	11.0	8.7	7.6	5.7	6.7	6.8	8.1	6.8	8.7	7.8
Same	72.9	75.3	63.2	72.3	84.0	77.3	70.3	79.5	78.4	76.4	67.1	76.0
Worse	18.1	16.8	25.4	18.7	8.3	16.1	23.0	13.4	13.3	16.4	24.0	16.0
Do not know	0.4	0.0	0.4	0.3	0.0	0.9	0.0	0.3	0.2	0.5	0.2	0.2
Score for MMSE, mean[a]	16.0	14.9	13.8	15.3	18.2	16.9	15.5	17.3	17.1	16.0	14.7	16.3

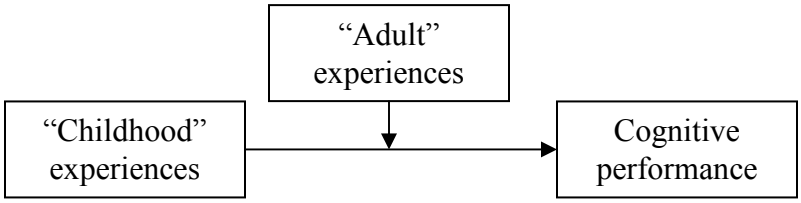
[a] Possible range 0 - 20

FIGURE 1. Models of the life course determinants of health in later life

The critical period and pathways hypothesis



The cumulative advantage/disadvantage or "turning point" hypothesis



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ENDNOTES

[1] Studies of mental health consistently show the protective effects of social integration (or the extent to which a person has social ties or social connections), as well as deleterious effects of social isolation and/or the loss of important social ties (see Seeman 1996). Much of this research, however, has focused on the protective effects of greater social ties, and the deleterious effects of their disruption, on an individual's risk of *depression* (e.g., Rogers 1994).

[2] At present, little is known about the *mechanisms* and *processes* that link socioeconomic position at each stage of life with cognitive function in adulthood. It is plausible, however, that being in a high socioeconomic position at any point is associated with greater exposure to more stimulating environments, more extensive development of the brain, and in turn a reduction in the propensity to experience poor cognitive performance in later life (Turrell 2002). Recent reviews of the relationship between education, cognitive function, and dementia provide some support for this process (e.g., Albert 1995).

[3] Such indicators may include measures of disease (history and incidence of stroke, ischemic heart disease, atherosclerosis, and diabetes), risk markers for these diseases (hypertension, blood lipids, fibrinogen, glucose, and insulin), and pharmacological agents (medications for control of hypertension and cholesterol) (Turrell et al. 2002).

[4] All figures mentioned come from the U.S. Census Bureau, International Database at http://www.census.gov/ipc/www/idbnew.html, downloaded September 1, 2005.

[5] Unless indicated, figures in this paragraph come from the United Nations Development Programme [UNDP] & Institute for National Planning [INP] (2003).

[6] Item non-response was especially high for the respondent's age at marriage. If we impute values for this variable, the sample size available for this analysis will increase considerably.