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ORIGINAL PAPER

Enduring mental health in the Baltimore epidemiologic catchment area follow-up study

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Abstract

Purpose To estimate the prevalence of enduring mental health (EMH) and examine important correlates of EMH 23 years later in the Baltimore Epidemiologic Catchment Area Follow-Up study.

Methods We estimated the prevalence of EMH among 964 adults with diagnostic data at all four study waves (1981–2004). Those with EMH were compared to those with any mental or behavioral disorder by demographic, psychosocial, and health characteristics. We used forward selection models to identify the most important predictors of EMH.

Results Twenty-six percent of participants met criteria for enduring mental health across the four waves. Neuroticism, GHQ-20 score, childhood conduct problems, female sex, maternal depression, and poor self-rated health were negatively associated with EMH.

Conclusions We identified several malleable factors associated with a decreased likelihood of enduring mental health. Interventions that target high neuroticism, childhood conduct problems, or maternal depression may increase the likelihood that children achieve EMH later in life. Identifying and treating other factors such as poor self-reported health and greater psychological distress may also keep sub-clinical symptoms from developing into a full mental or behavioral disorder.

Keywords Enduring mental health · Resilience · Psychiatric epidemiology · Prospective cohort study

Introduction

Mental and behavioral disorders are a growing source of disability globally. Between 1990 and 2010, the disability-adjusted life years lost due to mental and behavioral disorders increased by 37.6% [1]. Therefore, the identification of factors that promote health, enhance wellbeing, and protect against illness is essential for effective public health practice. Resilience and mental health promotion have been core components of the public mental health field from its inception, but have received relatively little attention in research compared to traditional risk factor epidemiology [2].

To further understand mental health resilience, epidemiologists need to identify specific phenomena that contribute to lifelong wellness. Most approaches to studying positive mental health do not fully capture the idea of mental wellness across the life course. Recently, Schaefer et al. made a breakthrough innovation in studying long term mental wellness by introducing the idea of enduring mental health (EMH) [3]. EMH is defined as the absence of any mental or behavioral disorder across the life course. Schaefer et al. found that 17% of individuals followed from birth to midlife never developed a mental or behavioral disorder [3]. This research is an important first step towards understanding lifelong resilience against mental illness, but more research is needed to replicate and extend these findings. Notably, the follow up in Dunedin cohort used by Schaefer et al. ended by age 38. This is an important limitation, as research has shown that the inter-quartile range for the age on onset of many disorders extends into participants' 40 s and many cases still onset in their 50 s or later [4, 5]. Given this limitation and known variability in mental health by region,

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more research is needed to fully understand EMH. EMH can only be effectively measured in a cohort study where mental health is repeatedly measured across time. Currently, only a few cohort studies exist in psychiatric epidemiology that can be used to study this phenomenon. The Baltimore Epidemiologic Catchment Area (ECA) Follow-Up Study is a prospective cohort study that followed adults aged 18 and older in the Baltimore area for 24 years, with four waves of data collection. The ECA study is well suited to extend previous findings through middle and later adulthood and further explore important factors in EMH over the life course.

The current study

We replicate Schaefer et al. [3] estimates of the prevalence of EMH in the United States. Second, we characterize the demographic, psychosocial, and health characteristics of individuals with enduring mental health as compared to those with any lifetime mental or behavioral disorder. Third, we identify important correlates of EMH using stepwise model selection.

Methods

Baltimore epidemiologic catchment area follow-up study

The Baltimore ECA is a longitudinal, population-based cohort study of non-institutionalized adults in eastern Baltimore city. Participants were recruited for Wave 1 in 1981 ($n=3481$). These participants were later asked to complete three follow up interviews: Wave 2 in 1982 ($n=2768$ completed interviews); Wave 3 in 1993–1996 ($n=1920$); and Wave 4 in 2004–05 ($n=1071$). Data collection for Wave 5 is currently underway. Attrition in the Baltimore ECA cohort was due to 1450 deaths, the inability to locate 524 survivors, and 436 participants refusing to participate in follow up interviews [6]. As previously described, refusal at follow up was not associated with psychopathology [6, 7]. Trained lay interviewers conducted in-person interviews at participants' homes. Additional details regarding the implementation of the Baltimore ECA have been described elsewhere [6]. The Baltimore ECA Study was conducted in compliance with the Johns Hopkins Bloomberg School of Public Health Institutional Review Board.

Participants

We limited our analyses to individuals from the Baltimore ECA who participated in all four waves ($n=975$). We removed an additional 11 participants from our sample due to conflicting information on diagnostic variables making it impossible to accurately determine if they met criteria for a mental or behavioral disorder. Our final analytic sample included 964 individuals. The average age of our sample at baseline was 35.4 years (SD = 13.0). Most of the sample (61.7%) was white and 36.5% of the sample was male.

Measures

Enduring mental health

We defined "enduring mental health" (EMH) as not meeting criteria for any lifetime mental or substance use disorder at Wave 1 and not meeting criteria for any incident disorder at any follow-up. Mental and substance use disorders were measured at each wave using the Diagnostic Interview Schedule (DIS) [8, 9]. The DIS is a structured clinical interview conducted by trained, lay interviewers that provides diagnoses for mental and behavioral disorders according to Diagnostic and Statistical Manual of Mental Disorders (DSM) criteria. DSM-III criteria were used for waves 1 and 2, while DSM-III-R was used for waves 3 and 4 [10, 11]. The disorders measured in the ECA study included mood (depression and bipolar), anxiety (all phobias, panic, generalized anxiety), obsessive compulsive, and drug and alcohol use disorders. Additionally, lifetime anorexia nervosa, conduct/antisocial personality disorders and schizophrenia were measured at wave 1 only.

Demographics

Demographic variables were measured at Wave 1. Participants self-reported their age, sex, race/ethnicity (White non-Hispanic, Black non-Hispanic, and other), education, veteran status, employment, and marital status. For employment, participants indicated whether they were working, unemployed, a homemaker, disabled, retired, a student, or something else ('other').

Psychosocial variables in adulthood

Social networks, personality, and religiosity/spirituality were the three psychosocial domains of interest in this study. Social networks were assessed at Wave 3 by asking participants how many friends and family members they keep in touch with and could discuss serious problems with. Participants chose from the following categories for number of family and friends separately: 0, 1, 2–3, 4–5, 6–10, and 11 or more. Five domains of personality were measured at Wave 4 using the NEO Personality Inventory (NEO-PI) [12]: openness, agreeableness, extraversion, conscientiousness, and neuroticism. Personality scores were generated in accordance with the standard NEO-PI scoring procedure [12]. The personality traits identified by the NEO-PI are considered

to be stable, enduring characteristics. We then standardized these scores within our analytic sample (M(SD) = 0(1)) and used the standardized scores for all analyses. We included measures of the importance of religiosity/spirituality, the frequency of seeking spiritual comfort, and frequency of attending religious services from Wave 3.

Physical/self-rated health and disability

All physical health and disability variables were measured at the first wave of the ECA. Participants reported whether a doctor ever told them that they have/had one or more of seven physical health conditions (asthma, diabetes, heart problems, high blood pressure, arthritis/rheumatism, stroke, and cancer), in addition to subjectively rating their own health (excellent, good, fair, or poor). They also completed the General Health Questionnaire-20 (GHQ-20), a self-administered screening test for psychological distress [13]. We included two measures of disability: any days of work/school/other missed and the number of days missed.

Childhood and family history

Three subcategories of childhood and family variables were measured: early conduct problems, family mental and physical health history, and family socioeconomic status during childhood. Early conduct problems were measured using the DSM-III symptom categories for conduct disorder at Wave 1. Participants reported how many of 12 different deviant behaviors they engaged in before the age of 15. Participants further reported whether each of their parents had any periods of severe depression during their lifetime (yes/no). At Wave 3, participants indicated their head of household's employment status (employed/not employed) and education at age 16. At Wave 4, participants reported on their family history of heart problems (heart disease, surgery, arteriosclerosis, and angina), hypertension, stroke, high cholesterol, diabetes, Alzheimer's Disease/memory loss, cancer (breast, prostate, and bowel), and asthma.

Attitudes towards mental health treatment

We included five measures on stigmatizing attitudes towards mental health treatment. Willingness to seek professional help for a mental health problem was measured on a four-point Likert scale (definitely, probably, probably not, definitely not). Participants also rated their comfort talking to a professional about their problems and embarrassment if others knew they were seeking professional help (very, somewhat, not very, not at all). Finally, participants reported how strongly they agreed or disagreed with two statements about the effectiveness of mental health treatment (people who get professional help do not get better; most people get better without professional help) on a four-point scale from strongly disagree to strongly agree.

Statistical analysis

All analyses were conducted using Stata 14 [14]. We first compared the prevalence of the variables described above by EMH status and tested for differences in the variables between the groups, using Chi-square tests, t tests, and non-parametric Mann–Whitney tests as appropriate. Due to the many descriptive comparisons we made, we selected a statistical significance threshold of $p = 0.01$. We then estimated the crude odds ratios for each significant correlate of EMH using logistic regression.

To identify the most important correlates of EMH we used a forward variable selection approach [15]. We estimated separate logistic regression models predicting EMH for the five categories of correlates (demographics, psychosocial variables, childhood and family history variable, physical and self-rated health, and mental health attitudes). All variables from each category were included in the models, except for any disability days due to multicollinearity problems with the number of disability days reported. All models used the same criteria for variable entry and removal. Variables entered the model if their associated p value was ≤ 0.05. Variables were removed from the model if their p value surpassed 0.1 once additional variables were added. For categorical variables, we entered variables as unordered indicators but required that all categories be entered or removed from the model together. We then took the variables selected by each categorical model and entered them into a final composite forward selection model. We considered the variables selected by the composite model to be the most salient correlates of enduring mental health. We conducted a sensitivity analysis ($n = 744$) comparing those with EMH to those who had brief or non-persistent mental disorders (i.e. had disorders at one or two waves) to see if the predictors of EMH changed based on the exclusion of those with persistent mental illnesses ($n = 220$). The sensitivity analysis followed the same analytic procedure as the primary analysis.

Results

Prevalence of enduring mental health

Of the 964 participants in our study, 250 met criteria for enduring mental health (25.9%) (Fig. 1). The remaining 74.1% of the sample reported a mental disorder at one or more waves. Twenty-seven percent ($n = 262$) met diagnostic criteria for a disorder at only one wave of the study. Twenty-four percent ($n = 232$) met diagnostic criteria at two study

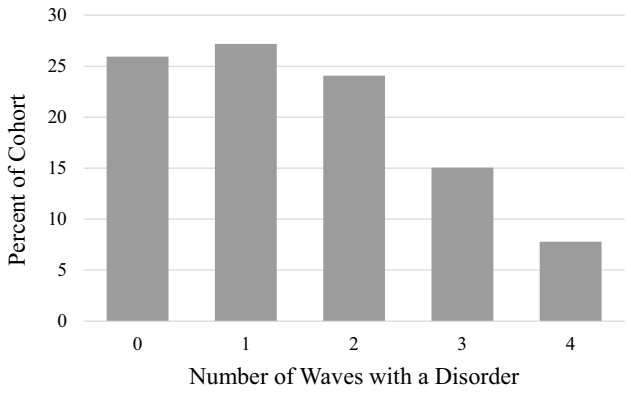

Fig. 1 Number of Waves at which Baltimore ECA Participants met DSM-III or DSM-III-R criteria for a Mental or Behavioral Disorder. Note: $N = 964$. The red bar represents individuals with "Enduring Mental Health," who comprised 25.9% of the sample. 27.2% met diagnostic criteria at one wave. 24.1% met criteria at two waves. 15.0% and 7.8% met criteria at three and four waves respectively. *ECA* epidemiologic catchment area, *DSM* diagnostic and statistical manual

waves, and 15% ($n = 145$) met criteria at three waves. The remaining 7.8% of the sample ($n = 75$) met criteria for a mental or behavioral disorder at every study wave. Among those with a mental or behavioral disorder, 28.9% reported lifetime mood disorders, 85.9% reported anxiety disorders, and 21.7% reported substance abuse or dependence.

Demographic associations with enduring mental health

Participants with EMH were similar to those with any mental illnesses (AMI) in age, race, education, veteran status, and marital status (Table 1). Those with EMH were more likely to be male (46.0 vs 33.2%; $\chi^2 = 13.1$, $p < 0.001$) and were more likely to be working (69.1 vs 61.2%; $\chi^2 = 18.02$, $p = 0.006$) than those with AMI.

Correlates of enduring mental health

Significant correlates of EMH are summarized in Table 2. All other correlates can be found in the supplemental materials.

Psychosocial variables in adulthood

The EMH group had lower standardized neuroticism scores than the AMI group (EMH $M(SD) = -0.4$ (0.8); AMI $M(SD) = 0.2$ (1.0); $t = -7.56$, $p < 0.001$). Individuals with EMH also reported having a larger number of friends than those with AMI ($\chi^2 = 15.32$, $p = 0.009$). The groups were similar in terms of family social networks, religiosity, and all other personality factors (Supplemental Table 1).

Physical/self-rated health and disability

The groups did not differ on personal histories of physical illnesses (Supplemental Table 2). However, the EMH group reported better self-rated health ($\chi^2 = 32.03$, $p < 0.001$) and lower GHQ scores (EMH $M(SD) = 13.2$ (4.2); AMI $M(SD) = 15.8$ (7.2); $t = -5.35$, $p < 0.001$), indicating lower psychological distress. Those with EMH were less likely to report having missed work, school, or other responsibilities due to disability in the past three months ($\chi^2 = 22.42$, $p < 0.001$). Among those who reported any disability days ($n = 388$), the groups did not differ in the mean number of days missed ($t = -1.02$, $p = 0.31$).

Childhood and family history

Family medical histories were similar between groups (Supplemental Table 3). Those reporting any mental illness were more likely to have a family history of asthma than the EMH group ($\chi^2 = 11.12$, $p < 0.001$). The groups did not differ on any other family physical medical conditions. Childhood family socioeconomic status was also similar between groups, as parental education and employment did not differ. EMH was negatively associated with maternal ($\chi^2 = 13.93$, $p < 0.001$), but only marginally with paternal ($\chi^2 = 5.34$, $p = 0.02$), history of depression. Finally, childhood conduct problems were also significantly inversely associated with EMH ($z = -4.68$, $p < 0.001$), with those with EMH reporting fewer conduct problems than those with AMI (EMH $M(SD) = 0.6$ (1.1); AMI $M(SD) = 1$ (1.5)).

Attitudes towards mental health treatment

The EMH and any mental illness groups had similar attitudes towards mental health treatment (Supplemental Table 4). However, people with EMH were more likely to be embarrassed if someone knew they were seeking professional help than those with mental illness ($\chi^2 = 12.36$, $p = 0.006$).

Key correlates of enduring mental health

The odds ratios for the significant correlates of EMH and the results of the forward variable selection analyses are summarized in Tables 2 and 3, respectively. The model for demographic correlates found sex to be the only significant factors for EMH. Being female was associated with a 43% decrease in the odds of EMH as compared to being male (OR = 0.57, 95% CI 0.43, 0.77). Neuroticism was the only significant adult psychosocial correlate identified. Each one standard deviation increase in neuroticism was associated with a 52% decrease in the odds of experiencing EMH (OR = 0.48, 95% CI 0.39, 0.59). Among health and disability factors, self-reported

Table 1 Demographic characteristics of EMH groups

	Enduring mental health ($N=250$)	Any mental illness ($N=714$)	Test statistic (p value)
Age, *M* (SD)	36.3 (14.0)	35.1 (12.6)	$t=1.3$ (0.19)
Sex, % male	46.0	33.2	$\chi^2=$ **13.1 (<0.001)**
Race, %			
Non-Hispanic white	64.8	60.6	$\chi^2=1.57$ (0.46)
Non-Hispanic black	31.6	36.0	
Other	3.6	3.4	
Education, %			
Less than HS	5.6	10.4	$\chi^2=9.92$ (0.04)
Some HS	16.8	20.5	
HS Diploma/GED	42.0	41.6	
Some college	20.0	15.8	
College degree	15.6	11.8	
Veteran, %	16.9	15.0	$\chi^2=0.52$ (0.47)
Employment, %			
Working	69.1	61.2	$\chi^2=$ **18.02 (0.006)**
Unemployed	4.8	2.5	
Home maker	18.5	27.3	
Disabled	0.4	1.7	
Retired	2.0	1.3	
Student	4.4	3.1	
Other	0.8	3.0	
Marital status, %			
Married	48.0	43.6	$\chi^2=6.85$ (0.14)
Widowed	6.0	5.3	
Separated	7.2	9.1	
Divorced	6.0	11.1	
Never married	32.8	30.9	

Demographic variables were from Wave 1 of the Baltimore ECA study

Bold indicates statistical significance at the $p<0.01$ level

EMH enduring mental health, *M* mean, *SD* standard deviation, *HS* high schoolm, *GED* general education diploma

health and GHQ-20 score were the two significant factors selected. Fair self-reported health was associated with 83% lower odds of EMH than excellent self-reported health (OR = 0.17, 95% CI 0.04, 0.78). The odds of EMH for those with good (OR = 1.14, 95% CI 0.62, 2.07) or poor (OR = 0.44, 95% CI 0.05, 3.70) self-reported health did not differ significantly from those reporting excellent health. A one-point increase on the GHQ-20 was associated with a 5% decrease in the odds of EMH (OR = 0.95, 95% CI 0.92, 0.98). Maternal depression and childhood conduct problems were the only significant correlates of EMH from the childhood and family history model. Those with mothers who had depression had 62% lower odds of EMH than those who did not have depressed mothers (OR = 0.38, 95% CI 0.18, 0.80). Similarly, each additional childhood conduct problem was associated with an 18% decrease in the odds of EMH (OR = 0.82, 95% CI 0.68, 0.98). Embarrassment about getting professional help was the only treatment attitude retained by the forward selection procedure, although none of the specific responses were significantly associated with EMH.

For the final model, we included all significant correlates from the domain-specific models. This model identified neuroticism, GHQ-20 score, childhood conduct problems, sex, maternal depression, and self-rated health as significant, independent correlates of EMH (Table 6). The estimated odds ratios for these variables were similar in the final combined model as in the domain-specific models. Embarrassment about seeking professional help was no longer significantly associated with EMH after accounting for these other variables.

Table 2 Significant bivariate correlates of enduring mental health

	Odds ratio	95% CI	*Z* (*p* value)
Female sex	0.58	(0.43, 0.78)	−3.60 (<0.001)
Employment			
Working	[REF]	–	–
Unemployed	1.68	(0.79, 3.56)	1.35 (0.177)
Homemaker	0.60	(0.42, 0.87)	− 2.73 (0.006)
Other	0.75	(0.43, 1.28)	− 1.05 (0.292)
Number of close friends			
0	[REF]	–	–
1	0.74	(0.31, 1.73)	−0.70 (0.481)
2–3	1.05	(0.54, 2.03)	0.14 (0.890)
4–5	1.43	(0.74, 2.77)	1.06 (0.291)
6–10	1.95	(1.02, 3.74)	2.01 (0.044)
11+	1.67	(0.83, 3.34)	1.44 (0.151)
Neuroticism Standardized Factor Score	0.49	(0.41, 0.60)	− 7.08 (<0.001)
Self-rated health			
Excellent	[REF]	–	–
Good	0.76	(0.56, 1.02)	−1.81 (0.071)
Fair	0.19	(0.10, 0.37)	−4.78 (<0.001)
Poor	0.17	(0.04, 0.74)	−2.36 (0.018)
GHQ-20 Score	0.96	(0.93, 0.99)	−2.99 (0.003)
Any disability days			
Number of childhood conduct problems	0.77	(0.67, 0.87)	−3.98 (<0.001)
Maternal history of depression	0.38	(0.23, 0.64)	−3.62 (<0.001)
Has asthma	0.47	(0.23, 0.93)	−2.17 (0.03)

GHQ General Health Questionnaire

Sensitivity analysis

The domain-specific model results were similar in sensitivity analysis (Table 4). The models for demographics, psychosocial factors, health and disability, and treatment attitudes remained the same in the sensitivity analysis. In the family history model, maternal depression was still retained in the model but childhood conduct problems was not. The final model retained four variables: neuroticism, GHQ-20 score, maternal depression, and self-rated health. The effect sizes in the final sensitivity model were similar to those in the main analysis.

Discussion

This study expands our understanding of EMH in the general population, beyond the findings of Schaefer et al. One quarter of our sample met our definition of EMH, which was similar to the 17% observed by Schaefer et al. [3]. Importantly, our study covered early through late adulthood, whereas the Dunedin study ends in participants 30 s [17, 18]. Our study extended these initial findings by covering middle and late life, when a variety of disorders do tend to onset [4, 5]. The small difference between the estimates is likely due to differences in methodology between the two cohort studies, even though the same structured interview was used to measure psychiatric disorders [19]. The ECA study only had four data collection waves, which makes it more susceptible to recall bias and may have underestimated the prevalence of some disorders in the population. Regardless, the similarities between the two studies indicate that between one-fifth and one-quarter of the population will experience enduring mental health throughout their lifetime.

We identified specific correlates of EMH in the ECA sample, which were broadly consistent with those from Schaefer et al. [3]. We found that neuroticism, psychological distress, childhood conduct problems, female sex, maternal depression, and self-rated health are some of the most important correlates of the absence of lifelong mental wellness in our sample. We found that neuroticism, childhood conduct problems, female sex, and maternal depression

Table 3 Results from the Forward Variable Selection Procedures on Enduring Mental Health

	Odds ratio	95% CI	*Z* (*p* value)
Domain-specific forward variable selection models			
Demographics			
Female sex	0.57	(0.43, 0.77)	−3.70 (<0.001)
Psychosocial factors			
Neuroticism Standardized Factor Score	0.48	(0.39, 0.59)	−7.13 (<0.001)
Health and disability			
GHQ-20 Score	0.91	(0.87, 0.96)	−3.27 (0.001)
Self-reported health			
Excellent	[REF]	–	–
Good	1.13	(0.64, 2.01)	0.42 (0.672)
Fair	0.07	(0.009, 0.55)	−2.53 (0.011)
Poor	0.44	(0.05, 3.70)	−0.75 (0.452)
Family history			
Maternal history of depression	0.38	(0.18, 0.80)	−2.56 (0.010)
Number of childhood conduct problems	0.82	(0.68, 0.98)	−2.22 (0.026)
Treatment attitudes			
Embarrassed about Professional Help			
Strongly disagree	[REF]	–	–
Disagree	1.33	(0.68, 2.62)	0.83 (0.409)
Agree	1.07	(0.52, 2.23)	0.18 (0.854)
Strongly agree	0.72	(0.37, 1.38)	−0.99 (0.323)
Final forward variable selection model			
Neuroticism Standardized Factor Score	0.54	(0.43, 0.66)	−5.74 (<0.001)
GHQ-20 Score	0.95	(0.92, 0.98)	−2.90 (0.004)
Number of childhood conduct problems	0.72	(0.61, 0.84)	−4.20 (<0.001)
Female sex	0.59	(0.41, 0.85)	−2.84 (0.004)
Maternal history of depression	0.45	(0.25, 0.81)	−2.66 (0.008)
Self-rated health			
Excellent	[REF]	–	–
Good	0.87	(0.61, 1.24)	−0.76 (0.445)
Fair	0.25	(0.11, 0.57)	−3.27 (0.001)
Poor	0.49	(0.11, 2.27)	−0.91 (0.363)

GHQ General Health Questionnaire

were all associated with a lower likelihood of experiencing EMH. These findings are similar to those from Schaefer et al. results [3]. Given the overall consistency of our findings with those of Schaefer et al., we can conclude that the factors that predict EMH are relatively consistent across different Western contexts. However, the question remains as to whether these same factors are transportable to other populations and contexts.

We further explored how physical and mental health are interrelated. Individuals with EMH were not less likely to experience any specific physical health conditions but on average they rated their own health as better than individuals with AMI did. This finding remained significant when controlling for the effect of psychological distress, which was also significantly associated with enduring mental health. One potential explanation for this is that it is common for physical health symptoms to accompany mental health symptoms. For example, sleep disturbances, fatigue complaints, and psychomotor agitation/retardation are three of nine possible symptoms in criteria for Major Depressive Disorder [20]. Fatigue, muscle tension, and sleep disturbances are also possible symptoms of Generalized Anxiety Disorder [20]. Therefore, poorer self-perceived health may be due to these symptoms, independent of psychological distress. Alternatively, the link between self-perceived health and mental illness could be due to a third factor that was not included in this analysis, such as inflammatory processes [21]. Better understanding the links between physical and mental health is a critical avenue of research if we are to prevent psychopathology and improve quality of life.

Table 4 Sensitivity analysis Results for predictors of having enduring mental health compared to having a brief or non-persistent mental illness

	Odds ratio	95% CI	*Z* (*p* value)
Domain-specific forward variable selection models			
Demographics			
Female sex	0.60	(0.44, 0.83)	−3.18 (0.001)
Psychosocial factors			
Neuroticism Standardized Factor Score	0.55	(0.44, 0.68)	−5.39 (<0.001)
Health and disability			
GHQ-20 Score	0.96	(0.93, 0.99)	−2.56 (0.010)
Self-reported health			
Excellent	[REF]	–	–
Good	0.81	(0.59, 1.13)	−1.25 (0.211)
Fair	0.25	(0.12, 0.51)	−3.82 (<0.001)
Poor	0.40	(0.09, 1.92)	−1.14 (0.254)
Family history			
Maternal history of depression	0.44	(0.20, 0.95)	−2.08 (0.037)
Treatment attitudes			
Embarrassed about professional Help			
Strongly disagree	[REF]	–	–
Disagree	1.26	(0.61, 2.58)	0.63 (0.531)
Agree	1.06	(0.49, 2.30)	0.15 (0.884)
Strongly agree	0.73	(0.36, 1.45)	−0.89 (0.371)
Final forward variable selection model			
Neuroticism Standardized Factor Score	0.59	(0.47, 0.74)	−4.63 (<0.001)
GHQ-20 Score	0.96	(0.93, 1.00)	−2.14 (0.033)
Maternal History of Depression	0.45	(0.25, 0.82)	−2.61 (0.009)
Self-reported health			
Excellent	[REF]	–	–
Good	0.84	(0.59, 1.21)	−0.91 (0.361)
Fair	0.27	(0.11, 0.63)	−3.04 (0.002)
Poor	0.55	(0.11, 2.74)	−0.73 (0.464)

GHQ General Health Questionnaire

Some of the correlates of EMH we identified were unexpected. Contrary to expectations, we did not observe that social isolation was a significant risk factor for psychopathology in our multivariate models, although there was a significant bivariate relationship between EMH and friend social network size. One potential explanation for this has to do with the developmental stage of life participants were in when social networks were measured. Most were in midlife at wave 3 of the study, and it's possible that at this time of life the size of one's social network is less important than the quality of relationships. This finding may also reflect a measurement problem, as we only measured social networks at a single point which cannot fully represent an individual's social environment throughout their life. Interestingly, people with EMH were more likely to be embarrassed if someone knew they were seeking professional help for a mental or behavioral problem than those with any mental illness. There are a few potential explanations for this effect. One possibility is that people with identified mental health disorders partially overcome their concerns about stigma through their interactions with the mental health treatment system. Another possibility is that individuals who do not have a diagnosed mental illness may be more concerned about explaining why they see a professional for help. This effect may also be due to response bias where individuals who would be embarrassed about needing treatment might be less likely to report symptoms of any disorder.

We selected the most salient factors for EMH using a forward selection process. Our final composite model selected sex, neuroticism, maternal depression, childhood conduct problems, psychological distress, and self-rated health as the most informative set of predictors of enduring mental health. While none of these individual predictors are particularly surprising, together they have some interesting implications for EMH promotion. Personality factors, like neuroticism, are heavily influenced by childhood experiences, such as parenting behaviors [16]. Childhood conduct problems are heavily influenced by the child's home environment,

including ineffective parenting behaviors [22]. Maternal, but not paternal, depression was selected. As our participants were largely raised in an era where mothers were expected to be the primary care giver for children, this suggests that the social impact of a primary caregiver with depression may be more salient to the long-term wellness of the child than the genetic elements of mental illness that each parent could contribute equally. In sum, these results re-emphasize the importance of the childhood social environment on lifelong mental wellness.

The results of the sensitivity analysis provided additional support for the predictors of EMH that our main analysis identified. Neuroticism, psychological distress, maternal depression, and self-rated health all had similar effect sizes in the sensitivity and main models. Female sex and childhood conduct problems fell out of the sensitivity model, suggesting that sex and conduct problems are more strongly related to long term mental health problems than they are to EMH. Overall, the sensitivity analysis supports the robustness of the predictors found in our main analysis.

This study is an important extension of Schaefer et al. work on EMH, although it has several limitations inherent to the design of the original ECA study. First, many of the predictors of interest were reported retrospectively at varying time points throughout the study. Therefore, it is possible that some factors were measured after disorder onset, making the study vulnerable to recall bias. While the ECA study does prospectively follow participants through adulthood, measurements of important childhood factors were retrospective and, therefore, subject to recall bias. Furthermore, the ECA study only included 4 waves of data collection over an extended time period, again likely resulting in recall bias. We were also unable to examine other potentially important childhood predictors of EMH, such as adverse childhood experiences and parenting style, as these variables were not collected in the Baltimore ECA study. We were also not able to differentiate between truly "resilient" individuals, those who were at risk but did not develop a disorder, and those who could be thought of as "immune", those who were not likely to develop the disease under any circumstances [23]. Since we are unable to make this distinction, our category of EMH and associated predictors do not necessarily solely reflect resilience. We must further acknowledge that the lack of illness does not necessarily indicate health or wellness. Thus, future longitudinal studies with rich information about wellness or whether a person is "thriving" are an important next step in furthering this line of research. Finally, the forward selection procedure used has some additional limitations, namely that forward selection procedures do not necessarily identify the model that best predicts the outcome [15].

Nonetheless, our study is an important extension of Schaefer et al. [3] initial work on enduring mental health by including an older sample, exploring additional predictors, and identifying the most salient predictors among them, which allows for prioritization of intervention strategies. Future studies need to continue exploring enduring mental health, building on this initial work. Studies that identify modifiable resilience factors for lifelong wellness are needed to inform public health interventions. Future studies should also target high-risk populations for mental disorders to confidently identify resilient individuals, rather than those who were not at risk for a disorder. Promoting enduring mental health continues to be a fundamental goal of the public mental health field.

Conclusions

Focusing on enduring mental health as a way to identify important components of resilience is a valuable strategy for public health efforts to intervene on mental and behavioral health. Future research needs to continue to build on these initial findings. Identifying modifiable contributors to enduring mental health will allow public health professionals to design and implement precise interventions to promote mental wellness. Ideally, studies with prospective data from childhood into adulthood should be used to identify truly prospective and modifiable factors that promote enduring mental health. Once resilience factors are well-identified, research should focus on developing effective interventions to increase the prevalence of these factors in both the general population and within targeted high-risk groups. Continuing to focus on resilience and mental health promotion is essential to the future of the public mental health field.

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Compliance with ethical standards

Conflict of interest No authors have any conflicts of interest to report.

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