Use of Life Course Work–Family Profiles to Predict Mortality Risk Among US Women

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Objectives. We examined relationships between US women's exposure to midlife work–family demands and subsequent mortality risk.

Methods. We used data from women born 1935 to 1956 in the Health and Retirement Study to calculate employment, marital, and parenthood statuses for each age between 16 and 50 years. We used sequence analysis to identify 7 prototypical work–family trajectories. We calculated age-standardized mortality rates and hazard ratios (HRs) for mortality associated with work–family sequences, with adjustment for covariates and potentially explanatory later-life factors.

Results. Married women staying home with children briefly before reentering the workforce had the lowest mortality rates. In comparison, after adjustment for age, race/ethnicity, and education, HRs for mortality were 2.14 (95% confidence interval [CI] = 1.58, 2.90) among single nonworking mothers, 1.48 (95% CI = 1.06, 1.98) among single working mothers, and 1.36 (95% CI = 1.02, 1.80) among married nonworking mothers. Adjustment for later-life behavioral and economic factors partially attenuated risks.

Conclusions. Sequence analysis is a promising exposure assessment tool for life course research. This method permitted identification of certain lifetime work–family profiles associated with mortality risk before age 75 years. (*Am J Public Health.* 2015;105:e96–e102. doi:10.2105/AJPH.2014.302471)

Over the past half-century, US women have fundamentally shifted the ways in which they combine the roles of employee, spouse, and parent. In 1935, 35% of women aged 25 to 54 years worked for pay; by 1970, participation climbed to 50%, and, by 1990, work rates had risen to the current level of 75%.[1] Marriage patterns also changed: women delayed age at first marriage, chose cohabitation over marriage, and divorced at higher rates than did their predecessors.[2–4] Finally, fertility remained at approximately 2 children per woman, although age at first birth rose.[5] Whereas for a woman born in 1930 a normative work–family trajectory was to marry in her early 20s and exit the labor force at the birth of her first child, patterns for subsequent birth cohorts have diversified.[6,7]

As the United States has few public social policies that support working parents (such as paid maternity leave or subsidized child care), certain work–family situations may generate competing demands, creating burdens of time, finances, and other resources.[8] Work–family strain, in turn, may predict future disadvantage and disease, including cardiovascular disease, psychiatric disorders, and health-damaging behaviors,[9–13] increasing mortality risk as a result. Consequences of work–family conflict may be more pronounced among single mothers without offsetting spousal, social, financial, or emotional support,[14] putting them at higher risk of smoking,[15] cardiovascular disease,[16] and mortality.[17] The same objective demand profile may have more profound health effects in lower–socioeconomic status (SES) versus higher-SES women.[11]

Research has identified long-term health impacts of work–family strain and has attempted to explain the phenomenon. The role accumulation hypothesis posits that marriage, children, and work promote health, individually and together.[18] The multiple role hypothesis suggests that, although these roles are salubrious individually, certain combinations of roles can impose competing health-damaging demands.[19] A major weakness in studies testing both theories is that work–family demands are typically assessed at a single point in midlife.[16,18] However, work–family circumstances often change many times during early life and midlife; one-time assessments of demands could obscure underlying patterns. Life course frameworks suggest that both exposure dose and timing can have an impact on later disease risk.[20,21] Thus, analysis of ages during which certain work–family demands might be especially toxic—and analyzing for whom toxicity is most profound—could enhance understanding of relationships between work–family demands and health.

We used the role accumulation and multiple roles frameworks to test whether patterns and timing of work–family combinations during early life and midlife (16 to 50 years) predicted subsequent mortality risk among US women. We hypothesized that high demands from work and home, with little offsetting support—for example, single working mothers—would be at greater risk for mortality between ages 55 to 75 years when compared with women in lower-strain work–family circumstances. We also hypothesized that hazards in higher-risk groups would be partially explained by sociodemographic characteristics, health behaviors, and economic factors at older ages.

METHODS

We used data from the US Health and Retirement Study (HRS), a longitudinal biennial survey of US adults aged 50 years and older. Design, sampling, and response rates are described elsewhere.[22] We restricted analysis to women with complete work–family data (see next paragraph) born between January 1936 and February 1956 (n = 7598). We eliminated 62 women who died between 51 years (end of exposure accrual) and 55 years (beginning of mortality follow-up) to reduce the possibility of illness exerting causal effects on exposure trajectories. Compared with those surviving to age

55 years, those dying between ages 51 and 55 years were more likely to be non-Hispanic Black (25.8% vs 17.8%), less likely to have graduated from high school (66.2% vs 77.5%), and more likely to be part of the single nonworking mother sequence (see next paragraph; 22.58% vs 6.5%). Our final analytic sample was 7536.

Life Course Work and Family Demands

Histories of marriage, childbearing, and work were collected at HRS interviews. Participants were asked about birth or adoption dates of children; beginning and ending dates of all marriages; and beginning and ending dates of current job (if nonretired), last job (if retired), longest-held job, and up to 3 other jobs. When complete ascertainment of work–family state for a given year could not be directly inferred, we imputed data by using proxy variables, such as total years worked. We performed these partial imputations for 3% of women's marriage histories, 24% of work histories, and 0% of child histories. Among those missing work data, we imputed an average of 9 years. We validated work history imputations against historical Social Security earnings, available for a subset of participants; imputations produced work histories similar to Social Security records.

We conceptualized work–family demands at each age between 16 and 50 years as 3 dimensions combined: children younger than 18 years (yes or no), married (yes or no), and working for pay (yes or no), parallel to other objective measures of work–family demands.[23] This produced a total of 8 possible work–family states, simplified to 6 states for analytic purposes. For each woman, we constructed an individual trajectory specifying work–family state at each age between 16 and 50 years—which, in our sample, meant nearly infinite (1.71×10^{27}) possible trajectories.

The 7536 women had 6489 distinct trajectories of work–family life, meaning that 86% of women had completely unique work–family histories. To group these diverse trajectories into scientifically meaningful clusters, we employed sequence analysis[24,25] to identify prototypical trajectories of life events based on observed temporal patterns within the sample.[26] Sequence analysis accounts for both timing of milestones (childbirth, marriage) and duration spent in a given state following transition, an improvement over techniques capturing timing or duration but not both.

We classified each participant by the prototypical sequence most closely resembling her unique trajectory. First, Halpin's modified optimal matching involves theoretical specification of "costs" of transforming one individual's sequence to match another. The goal is to select a match with minimum cost (pairwise distance), as there are multiple ways of transforming one sequence to resemble another. Optimization is performed by using an algorithm[27] based on number of elementary operations, substitutions, and indel (insertion and deletion) costs needed to make 2 sequences alike. We calculated substitution costs by using mean probability distance, based on the observed mean of a particular transition's probability.[27] For example, transitions from married nonworking mother to married working mother were frequent; transitions from nonworking single mother to married working mother were rare. The former would have lower substitution costs than the latter. Indel costs are set to 1, slightly more than half the highest substitution cost.[10] The algorithm weights basic operations of optimal matching inversely with episode length, emphasizing both duration of given states and transition costs.[28]

Next, we performed hierarchical clustering to obtain distinct clusters of similar life trajectories and determined the optimal number of clusters. A 7-cluster solution mathematically optimized dispersion of within- and between-cluster differences as measured by the Calinski–Harabasz pseudo-F test[25] (Table A, available as a supplement to the online version of this article at http://www.ajph.org). This solution, classifying each woman into 1 of 7 clusters, produced maximum within-cluster homogeneity of work–family experiences and maximum between-cluster heterogeneity.

All-Cause Mortality Outcome and Covariates

We ascertained dates of deaths (all-cause) occurring after the 55th birthday and before March 2011 (last available data) by using the National Death Index, with proxy reports for post-2008 deaths (National Death Index data not available).

Covariates included birth month and year (divided into 3 equal-sized groups for descriptive and analytic purposes; Table B, available as a supplement to the online version of this article at http://www.ajph.org), self-reported race/ethnicity (non-Hispanic Black, non-Hispanic White, Hispanic, multiracial or other), education (< high school, ≥ high school), smoking status (never, former, current), body mass index (BMI; defined as weight in kilograms divided by the square of height in meters) category (underweight, normal weight, overweight, obese), and household wealth quintile based on sample distribution of wealth. Sociodemographic variables were collected upon HRS enrollment; BMI, smoking, and wealth were calculated from the HRS interview closest to the 55th birthday. We also considered constructs related to family formation: age at first birth, total number of children, marital status at first birth.

Statistical Analyses

Among 7536 participants surviving to age 55 years, we documented frequency and distribution of the 7 work–family sequences by birth cohorts, education, and race/ethnicity.

Next, we calculated age-standardized mortality rates (ASMRs) to compare absolute mortality by sequence. We calculated each participant's age in 1990. Using indirect standardization and standardizing to the US population age distribution in 1990,[29] the most recent US census in which our entire sample was alive, we calculated ASMRs for each sequence and associated 95% confidence intervals. We used the Welch t test for unequal variances[30] to test for significant differences between groups, with $\alpha = 0.01$ to account for multiple comparisons. We used the Cox proportional hazards model to test associations between sequences and mortality risk, adjusting sequentially for demographics (age, race/ethnicity, education), behaviors (smoking, alcohol consumption, BMI), and household wealth.

To test whether sequences accurately accounted for work–family experiences known to be risk factors for poor health,[31] we adjusted for age at first birth, total number of children, and marital status at first birth. Minimal attenuation of coefficients would indicate that sequences captured these risk factors.

We generated sequences with Stata version 12 (StataCorp, College Station, TX), with established algorithms.[27] We performed all other analyses with SAS version 9.3 (SAS Institute Inc, Cary, NC).

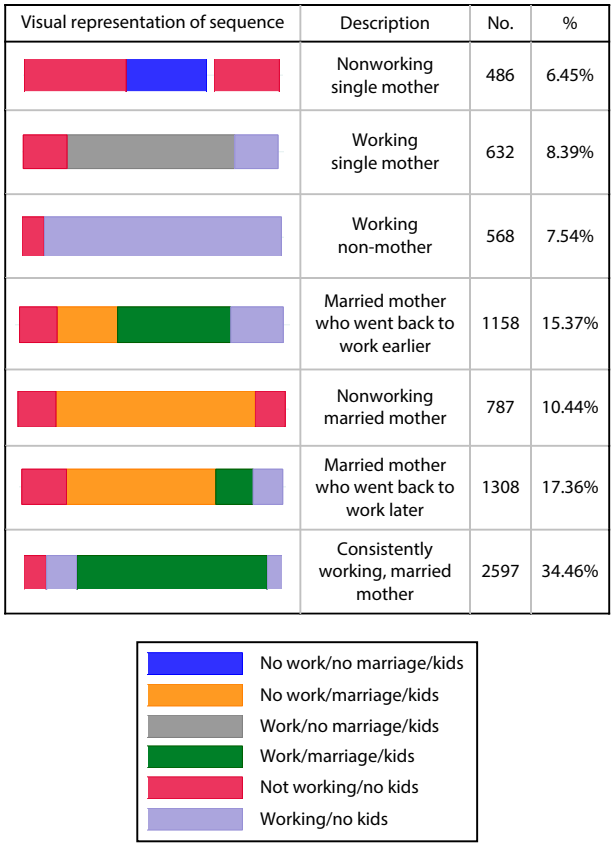
RESULTS

Among 7536 participants, there were 705 (9.4%) deaths. Mortality varied by age, race, education, and smoking status (Table B, available as a supplement to the online version of this article at http://www.ajph.org).

Of the 7 work–family patterns, most common was the pattern identifying consistently working married mothers (35% of sample; Figure 1), followed by married mothers who stayed home with children for many years before working (17%), and by married mothers who stayed home with children for fewer years before working (15%). The other sequences were married women with children who never worked outside the home (10%), women who worked but did not have children (8%), women with a long spell as a working single mother (8%), and women experiencing a prolonged period of single, nonworking motherhood (6%).

Sequence distribution shifted over successive birth cohorts (Figure 2). In the 1935 to 1939 cohort, 31% of women were consistently working, married mothers, rising to 39% for the 1947 to 1956 cohort. The prevalence of women without children, and of single motherhood, increased over time; conversely, permanently nonworking mothers decreased from 13% in the 1935 to 1939 cohort to 8% in the 1947 to 1956 cohort.

Sequence distribution varied by education and race/ethnicity. Among non–high school completers, 13% were nonworking single mothers, versus 4% among graduates. Disparities were also observed by race/ethnicity, with 19% of non-Hispanic Black women classified as single working mothers, versus 6% of non-Hispanic White women and 8% of Hispanic women.



Note. Visual sequences represent the age span from 16 to 50 years, with time moving from left to right.

FIGURE 1—Distribution of women born between 1935 and 1956 by work–family sequence: Health and Retirement Study, United States.

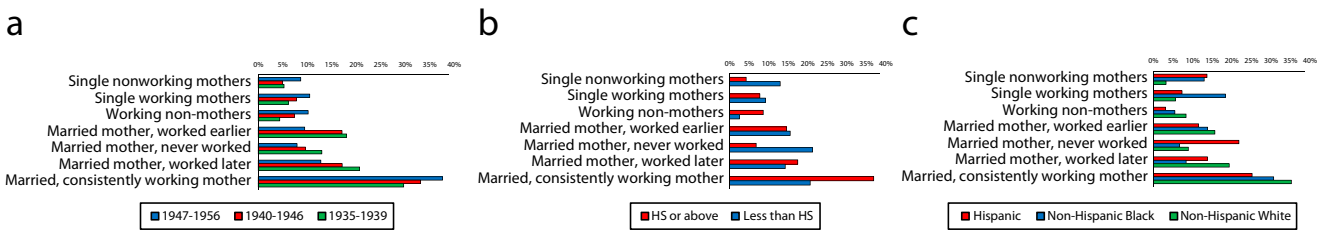
In Figure 3, we calculated ASMRs, standardized to the 1990 US population age distribution, for each sequence; all rates are per 1000 women. The lowest overall ASMR was among married mothers who were out of the workforce for several years with children (ASMR = 48.5; 95% confidence interval [CI] = 36.3, 60.7), and was 50.48 (95% CI = 39.2, 61.8) for those who were out of the workforce for longer before working. Compared with these latter 2 groups, mortality was slightly (though nonsignificantly) higher among married, consistently working mothers (60.4; 95% CI = 51.3, 69.5); among married mothers who never worked (66.8; 95% CI = 51.6, 82.0); and among working nonmothers (59.0; 95% CI = 39.4, 78.5). None of the preceding mortality rates were significantly different from each other.

Single nonworking mothers had the highest ASMR (121.5; 95% CI = 94.6, 148.4), significantly higher than all other groups ($P < .01$), followed by single working mothers (83.1; 95% CI = 60.9, 105.3), whose mortality rate was significantly higher than the 2 lowest-mortality groups ($P < .01$).

We modeled relative associations between work–family sequences and mortality, adjusting sequentially for sets of social and behavioral risk factors (Table 1). The lowest-mortality sequence—working married mothers who stayed home briefly—was the reference group. The 2 single-mother sequences had the highest unadjusted mortality hazards, with an HR of 2.49 (95% CI = 1.85, 3.36) for nonworking single mothers and 1.66 (95% CI = 1.22, 2.25) for working single mothers. Married nonworking mothers also had elevated risk (1.40; 95% CI = 1.06, 1.86).

Upon adjustment for birth cohort, education, and race/ethnicity, associations were attenuated by 14% for nonworking single mothers and by 11% for married single mothers, but increased effect estimates by 7% for consistently working, married mothers, from 1.18 (95% CI = 0.93, 1.49) to 1.25 (95% CI = 0.99, 1.59). For married nonworking mothers, HRs remained elevated (1.35; 95% CI = 1.02, 1.80).

Adjusting for potential mediators at age 55 years (smoking, BMI) attenuated risk among single working mothers by 7% to marginal significance (1.37; 95% CI = 0.99, 1.90), but increased risk among married nonworking



Note. HS = high school. Percentages are calculated within the groups being compared, rather than within clusters.

FIGURE 2—Percentage distribution of 7 identified work–family sequences for women born between 1935 and 1956 by (a) birth cohort, (b) education level, and (c) race/ethnicity: Health and Retirement Study, United States.

mothers, from 1.35 (95% CI = 1.02, 1.80) to 1.44 (95% CI = 1.06, 1.95).

Finally, we also adjusted for household wealth quintiles at 55 years to assess whether later-life socioeconomic circumstances attenuated associations. Attenuations were strongest among single mothers: among those who did not work, the HR decreased from 2.10 (95% CI = 1.52, 2.89) to 1.72 (95% CI = 1.22, 2.44). Among those who worked, the HR decreased from 1.37 (95% CI = 0.99, 1.90) to 1.26 (95% CI = 0.90, 1.76). The only other sequence still significantly associated with mortality risk was married stay-at-home mothers (1.40; 95% CI = 1.02, 1.92).

To test whether sequences captured facets of family formation associated with mortality in previous studies, we examined whether additional adjustment for these facets attenuated HRs (Table C, available as a supplement to the online version of this article at http://www.ajph.org). We excluded nonmothers. Adjustment for these features of parenthood changed effect estimates very little.

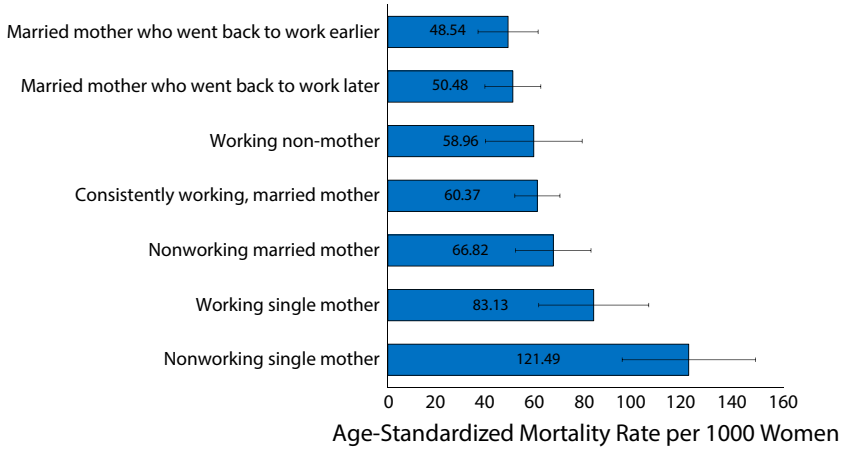
We tested all models for, and they all met, the proportional hazards assumption.

DISCUSSION

Among US women born between 1935 and 1956, lifetime trajectories of work–family demands predicted mortality risk at ages 55 through 75 years. We used sequence analysis to identify 7 prototypical ways in which women combined work, marriage, and children between ages 16 and 50 years. Women spending most of their adult lives as single mothers (working and nonworking) were at greatest risk of dying during follow-up, followed by nonworking married mothers. Married women out of the workforce when their children were young were at lowest risk. Effects were partially explained by behavioral factors and household wealth in later adulthood.

Previous studies suggest that single mothers are at heightened risk for morbidity and mortality, particularly for those experiencing other forms of social disadvantage such as poverty.[16,17,32–34] However, most previous studies have not taken work history into account, nor have they used lifetime measures of work–family demands. This life course perspective on exposure is critical: almost all women transitioned from one work–family state to another during midlife. A cross-sectional exposure assessment would have obscured substantial differences in mortality risk revealed through sequence analysis. Our study adds evidence that health impacts of prolonged single motherhood may continue past active childrearing, and that working women are at lower risk than those with similar family situations but who do not work.

Literature to date on work–family demands and health offers 2 primary hypotheses, emphasizing either accumulation of opportunity or demands of multiple roles.[18,19] The multiple role hypothesis postulates that simultaneous functions of spouse, parent, and employee impose competing demands especially for women, and resultant role conflict or role overload is detrimental to health.[8] Conversely, role accumulation suggests that simultaneous experience of marriage, parenthood, and work provides enhanced opportunities for social



Note. Mortality rates are for age 55–75 years.

FIGURE 3—Age-standardized mortality rates and 95% confidence intervals per 1000 women born between 1935 and 1956, for each of the 7 identified work–family forms: Health and Retirement Study, United States

TABLE 1—Hazard Ratios (HRs) for Women Born Between 1935 and 1956 for Each of the 7 Identified Work–Family Forms: Health and Retirement Study, United States

Work–Family Form	Model 1,[a] HR (95% CI)	Model 2,[b] HR (95% CI)	Model 3,[c] HR (95% CI)	Model 4,[d] HR (95% CI)
Married mother, worked earlier (Ref)	1.00	1.00	1.00	1.00
Single nonworking mother	2.49 (1.85, 3.36)	2.14 (1.58, 2.90)	2.09 (1.51, 2.89)	1.72 (1.21, 2.44)
Single working mother	1.66 (1.22, 2.25)	1.45 (1.06, 1.98)	1.37 (0.99, 1.90)	1.26 (0.90, 1.76)
Working nonmother	1.23 (0.86, 1.77)	1.38 (0.96, 1.99)	1.38 (0.94, 2.02)	1.28 (0.86, 1.93)
Married nonworking mother	1.40 (1.06, 1.86)	1.35 (1.02, 1.80)	1.44 (1.06, 1.95)	1.38 (1.01, 1.90)
Married mother, worked later	0.93 (0.71, 1.23)	1.00 (0.76, 1.32)	1.03 (0.76, 1.37)	1.02 (0.76, 1.39)
Married mother, always worked	1.18 (0.93, 1.49)	1.25 (0.99, 1.59)	1.24 (0.97, 1.60)	1.21 (0.94, 1.57)

Note. CI = confidence interval.
[a]Bivariate.
[b]Adjusted for age, education, and race/ethnicity.
[c]Adjusted for model 2 plus smoking and body mass index (defined as weight in kilograms divided by height in meters squared) at age 55 years.
[d]Adjusted for model 3 plus household wealth quintile at age 55 years.

engagement, financial independence, and fulfillment, leading to improved health.

To date, the majority of evidence supports role accumulation.[35,36] We found that mortality rates were generally lowest for those simultaneously combining the 3 roles of mother, spouse, and worker (supporting role accumulation). However, removing 1 or more of those roles may induce strains between the remaining roles, contributing to poor health, in a variation of the multiple role hypothesis. Although not all differences were statistically significant, the lowest age-standardized mortality rates were among women combining the 3 roles of marriage, work, and child-rearing (married mothers going back to work earlier at 48.5 per 1000; married mothers going back to work later at 50.5; consistently working, married mothers at 60.4). We observed moderate mortality rates among those filling 2 of 3 roles (working nonmother, at 58.96; nonworking married mother, at 66.82; working single mother, at 83.1). Mortality was highest among those filling 1 role (nonworking single mothers at 121.5). These general patterns persisted in regression analyses after we adjusted for confounders such as age, education, and race/ethnicity.

Associations between accumulation of roles and health may be partially attributable to selection. Healthier people tend to work,[37] be married,[38,39] and have children[40]; selection may be compounded when domains are considered simultaneously. Though research suggests that causation may play a stronger role than selection in explaining associations between work–family status and health,[41] we cannot rule out selection. However, adjustment for early life structural factors that may influence selection into single motherhood—such as non-White race and low educational attainment—failed to fully explain effects. Thus, work–family strain may carry risks correlated with but ultimately independent of earlier-life determinants of health.

Adjusting for chronic disease risks and SES at older ages (smoking, BMI, wealth) attenuated HRs in the 2 single-mother sequences, but increased HRs among married nonworking mothers. This "masking" in the latter group may occur because of lower prevalence of risks, but greater underlying mortality risk than their working counterparts because of physical and mental health benefits of working. Results may also be mediated by health care access, in addition to selection: unmarried, nonworking women may not have access to employer-sponsored health insurance and suffer long-term health consequences as a result. Unfortunately, we do not have historic data on health coverage to test this hypothesis.

Behavioral factors may be mediators, rather than confounders, as we hypothesize that they are on the pathway between work–family patterns and mortality risk. Smoking and obesity potentially represent stress coping[9,13,42]; attenuation upon adjustment for smoking and BMI among single mothers suggests that these factors partially explain greater mortality risk for those with conflicting work and family responsibilities. This supports findings that smoking may help explain the longevity gap between US and European women.[43]

Greater relative wealth may offset strains associated with working motherhood by permitting access to goods and resources.[32] Adjustment for household wealth at age 55 years attenuated HRs to nonsignificance, except in married stay-at-home mothers. The latter finding may be attributable to that group having greater wealth on average. As participants generally enrolled in HRS once they had already turned 50 years old, unfortunately we do not have comparable wealth metrics during the exposure period.

Limitations

Our exposure assessment method has several shortcomings.[26] In particular, because we summarized work–family experiences, we collapsed the 7536 participants—representing 6489 unique work and family sequences—into 7 groups, resulting in loss of nuance and obscuring between-individual differences in work–family experience among those in a given sequence. However, such summarization is necessary to uncover broader population patterns.

There are also limitations to work–family measures used to construct the sequences. First, we were unable to distinguish between nuances of our 3 elements of work–family life such as part-time versus full-time work; adoption versus biological childbearing versus step-parenting; or dependent children living at home past 18 years old. For work, we collapsed part-time and full-time work, although part-time work is associated with fewer health risks.[44,45] This choice was mainly practical, and is a limitation of sequence analysis: even if rare states or combinations are included in initial exposure assessments, rare combinations often disappear in final cluster solutions because of the need to create a small number of clusters from a wide range of lived experiences.

Second, we used objective measures of work–family state, rather than perceived work–family conflict. Our metric permitted a life course approach to work–family histories,

a novel contribution of this study. However, the lack of appraisal assumes that all individuals with the same work–family context have similar work–family demands, perhaps a strong assumption in that health effects vary by whether spillover is positive or negative.[46,47] Future studies could explore heterogeneity in work–family demands by incorporating perceived home demands into measures of work stress[48] or vice versa,[11,12] and could also take into account additional variables during the exposure period such as perceived spousal support or additional socioeconomic measures.

Conclusions

Despite limitations, sequence analysis is an important advance in providing measures that correspond with theoretically relevant aspects of work–family experiences. Typically, workplace or cross-domain exposures—particularly psychosocial exposures—are measured in midlife, and participants' health is subsequently tracked longitudinally. However, few studies have taken a life course perspective on exposure. In light of varying mortality rates among the 3 sequences containing women who worked when their children were older, assessment of work–family demands at 40 years would have assigned the same work–family state (married, working, and with children younger than 18 years) to women in all 3 sequences, even though their total work–family experiences—and mortality risks—differ. This is also true among those who stayed home with young children. To date, sequence analysis has been primarily used for description rather than exposure assessment. Our findings speak to the method's predictive utility for health outcomes.

Findings have implications for both research and policy. Results highlight the necessity of life course perspectives in exposure assessment, as nearly all women made at least 1 major role transition between ages 16 and 50 years; a single assessment would have obscured those differences. We present and explore sequence analysis as a method for public health studies.

From a policy perspective, we identified potential future health consequences of growing numbers of US women parenting alone while working, absent social policies that could provide offsetting support. Whereas strong social safety net policies in Europe may fill this role, lack of such policies in the United States—and ongoing cuts to basic social programs—may further strain resources among women balancing work–family demands.

Overall, results suggest that mortality consequences of work–family strain may persist for years beyond active childrearing, and that lifelong work–family patterns can profoundly affect health. ■

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This article was accepted November 11, 2014.

Contributors

E. L. Sabbath co-generated hypotheses, conducted regression analyses, and drafted the article. I. M. Guevara conducted all sequence analyses. M. M. Glymour and L. F. Berkman guided conceptualization and analyses and edited the article.

Acknowledgments

This study was funded by the National Institute on Aging (5R01AG040248-03; Principle Investigator: L. F. B.) and supported by the John D. and Catherine T. MacArthur Foundation Network on an Aging Society.

Human Participant Protection

The Health and Retirement Study was approved by the University of Michigan human participants committee. Data used for the present study were determined to be exempt by the Harvard University human participants committee.

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