2013

An Integrative, Multilevel, and Transdisciplinary Research Approach to Challenges of Work, Family, and Health

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Citation Details

Bray, J. W., Kelly, E. L., Hammer, L. B., Almeida D. M., Dearing, J. W., King. R. B., & Buxton, O. M. (2013). An integrative, multilevel, and transdisciplinary research approach to challenges of work, family, and health. RTI Press publication No. MR-0024-1303. Research Triangle Park, NC: RTI Press. Retrieved from http://www.rti.org/rtipress

METHODS REPORT

An Integrative, Multilevel, and Transdisciplinary Research Approach to Challenges of Work, Family, and Health

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March 2013

RTI Press

RTI INTERNATIONAL

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This publication is part of the RTI Method Report series.

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RTI Press publication MR-0024-1303

Suggested Citation

Bray, J. W., Kelly, E. L., Hammer, L. B., Almeida D. M., Dearing, J. W., King. R. B., & Buxton, O. M. (2013). *An integrative, multilevel, and transdisciplinary research approach to challenges of work, family, and health.* RTI Press publication No. MR-0024-1303. Research Triangle Park, NC: RTI Press. Retrieved from http://www.rti.org/rtipress

http://dx.doi.org/10.3768/rtipress.2013.mr.0024.1303

www.rti.org/rtipress

An Integrative, Multilevel, and Transdisciplinary Research Approach to Challenges of Work, Family, and Health

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Abstract

Recognizing a need for rigorous, experimental research to support the efforts of workplaces and policymakers in improving the health and wellbeing of employees and their families, the National Institutes of Health and the Centers for Disease Control and Prevention formed the Work, Family & Health Network (WFHN). The WFHN is implementing an innovative multisite study with a rigorous experimental design (adaptive randomization, control groups), comprehensive multilevel measures, a novel and theoretically based intervention targeting the psychosocial work environment, and translational activities. This paper describes challenges and benefits of designing a multilevel and transdisciplinary research network that includes an effectiveness study to assess intervention effects on employees, families, and managers; a daily diary study to examine effects on family functioning and daily stress; a process study to understand intervention implementation; and translational research to understand and inform diffusion of innovation. Challenges were both conceptual and logistical, spanning all aspects of study design and implementation. In dealing with these challenges, however, the WFHN developed innovative, transdisciplinary, multi-method approaches to conducting workplace research that will benefit both the research and business communities.

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Introduction

Managing work and family responsibilities in the United States is often difficult for employees and their families. Negative impacts of the resulting stress on the health and well-being of employees and their families and on the productivity and culture of the workplace are common (Hammer & Zimmerman, 2011). The challenge of balancing work and family obligations affects white- and blue-collar workers and cuts across industries.

These challenges are exacerbated by societal trends, such as longer work hours in professional and managerial jobs, long commute times, dual-income households, and single working parents, and economic trends, including stagnant wages, contingent work, and job insecurity and instability. Simultaneously, family-friendly or work-life policies in US workplaces have increased dramatically (Galinsky, Bond, Sakai, Kim, & Giuntoli, 2008; Holzer, 2005; Kelly, 2003; Kossek, 2005). Yet few longitudinal studies have used experimental designs to evaluate the effects of specific work-family interventions on work-family conflict and health outcomes (Brough & O'Driscoll, 2010; Kelly et al., 2008).

Rather, most studies have been observational assessment of efforts initiated by the workplaces under study. For a review of the relevant literature, see Kelly et al. (2008); and for an exception, see Hammer, Kossek, Anger, Bodner, and Zimmerman (2011). Furthermore, despite advances in sociological and epidemiological theorizing of the effects of social environments on health (e.g., Taylor, Repetti, & Seeman, 1997; Hale, 2010; Berkman, 2005; Berkman & Sivaramakrishnan, 2008; Kumar, Calvo, Avendano, Sicvaramakrishnan, & Berkman, 2012), few empirical studies have examined changes in social structures and how these changes affect individuals or objective health outcomes.

To address this gap in the knowledge base supporting work-family policies, the National Institutes of Health (NIH) and the Centers for Disease Control and Prevention (CDC) formed the Work, Family & Health Network (WFHN). The WFHN is a two-phase, transdisciplinary research effort designed to enhance understanding of the impact of workplace practices and policies on work, family life, and health outcomes and to illuminate the processes through which such practices and policies are adopted by employers and implemented by managers and employees (see King et al., 2013). The WFHN draws on expertise from sociology, economics, social epidemiology, organizational behavior, occupational health psychology, human development, demography, and dissemination science.

Phase 1 of the WFHN activities consisted of 3 years of pilot research by four developmental centers, a logistics coordinating center, and a methods coordinating center.

For Phase 2, the NIH and CDC sponsored the WFHN to implement an innovative workplace intervention and to conduct a large-scale evaluation using a group-randomized experimental design, the Work, Family, and Health Study (WFHS). This intervention is designed to increase employees' control over their work time and increase supervisor and coworker support for employees' family and personal lives (see Kossek, Hammer, & Kelly, 2012). The intervention includes participatory work redesign activities that identify new work practices and processes that increase employees' control over work time while still meeting business needs. The intervention also includes supervisory training about strategies to behaviorally demonstrate support for employees' family and personal lives while supporting employee job performance, as well as tracking exercises to encourage supervisors and employees to put the training into practice.

To fully understand the effects of this intervention, it is important to understand how the multifaceted pressures of work and family form an environmental context influencing the health and well-being of employees and their family members. Epidemiological evidence suggests that job and family demands each have important effects on health, but understanding their complex interactions goes beyond any single research paradigm and requires a transdisciplinary, multilevel approach (Bhave, Kramer, & Glomb, 2010; Bliese & Jex, 2002). Past research on work and family demands has relied on information obtained at the employee level (Grzywacz, Butler, & Almeida, 2008). However, work

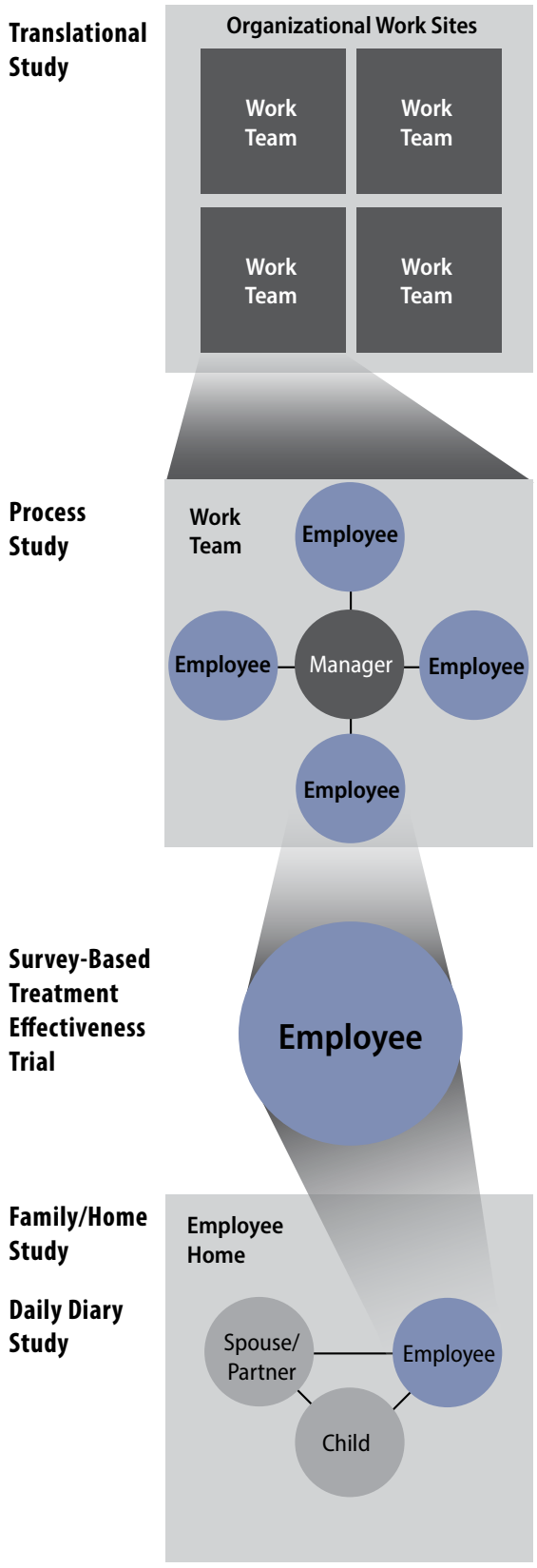
and family demands are embedded across multiple levels of settings and depend upon other individuals (e.g., coworkers, family members) and characteristics in these settings.

As illustrated in Figure 1, the WFHS uses a variety of methods to examine the effects of the study intervention at multiple levels, including the organization, work team, manager/supervisor, employee, and family. At the core of the design is an employee-level treatment effectiveness study (Flay, 1986) that assesses the effects of the intervention on employees and a family/home study that assesses the effects of the intervention on families. To yield a more in-depth understanding of how work-family conflict and the WFHN intervention affect family functioning, a daily diary sub-study examines the daily experiences of families and includes self-reported and biological measures of stress. Similarly, an in-depth process sub-study seeks to understand the workplace context in which the intervention is implemented, the fidelity of the intervention, and the impact of the intervention on the work site and the broader organization. Finally, translational activities will yield information about how best to position the results of the WFHS so as to attract the attention of decision makers in the broader business community whose organizations are logical potential adopters of our intervention.

This paper presents the methods of the WFHS to support future publications that will present results from this innovative and complex study. It does not attempt to present all methods in full detail or to present specific study hypotheses or measurement approaches because providing that level of detail on all aspects of the WFHS is beyond the scope of any single paper. Rather, this paper is intended to serve as a single source synopsis of the WFHS methods and design.

Within the workplace, in particular, there are practical and scientific challenges with identifying and implementing changes that are amenable to employers, useful for employees, and supportive of families, and additional challenges with evaluating those changes in ways that are convincing to a scientific audience and other stakeholders. We use these challenges as an organizing framework for describing the methods we have developed or elaborated to address various challenges.

Figure 1. The multiple levels and methods of analysis in the Work, Family, and Health Study (WFHS)



One challenge was to conduct experimental research, specifically a group-randomized trial, in dynamic organizations and to integrate organizational and pragmatic needs for balance across conditions on some factors with scientific requirements for internal validity. A second challenge was to collect data to evaluate which intervention effects were meaningful for a variety of stakeholders—researchers from different disciplines, employees, family members, participating employers, and potential adopters—and to motivate all stakeholders to share information as requested over a relatively long time period. A third challenge was to identify analysis approaches that are broad enough to meet the needs of this multidisciplinary team examining a wide variety of outcomes but integrated enough to facilitate the accumulation of knowledge across the project and rigorous enough to convince evaluation scholars. A fourth challenge was to understand how the intervention affects the daily lives of employees and their families, particularly how work stressors cross over into family life. The final challenge was to implement a participatory initiative that targets the aspects of the psychosocial work environment that theory and our previous studies have emphasized—in other words, to combine structured messages with variable implementation as workers put these ideas into practice. After a broad overview, the remainder of this paper reviews these challenges and describes how we developed the design and methods to address them.

Overview of Study Design

The WFHN conducted group-randomized field experiments with two large companies from different industries. Specifically, we focused on a lower-wage, hourly workforce in one company and a higher-wage, professional workforce in the other. The effectiveness study treats each company as a separate field experiment and therefore does not require (or support) pooling data across industries to meet study objectives for statistical power. Rather, the two experiments are viewed as concurrent replications; each is focused on internal validity (making strong causal claims) within a company.

We paired two disparate companies for the concurrent replications to partially address concerns that findings are not generalizable beyond a single industry or type of workforce, in support of translation and dissemination efforts. The WFHN recruited distinct work sites of 5 to 117 employees from each company. Employees reporting to the same frontline supervisor made up a work team, with multiple work teams within each work site.

In Company 1, consisting of the lower-wage, hourly workforce, work sites are geographically distinct at 30 physical locations spread across six states. In Company 2, consisting of the higher-wage, professional workforce from a more centralized company, 56 work sites were identified for the WFHS. Work sites in Company 2 are groups of employees who report to the same senior management team (roughly analogous to departments). A site may involve employees from up to four physical locations in two US cities, but these employees report to the same manager(s) and generally do similar work. Coordinating work remotely may affect employees' stress and health at baseline and perhaps moderate the effects of the intervention (described below). However, sites' geographic distribution was balanced across treatment and control condition by the randomization algorithm (described below). For ease of exposition, hereafter we refer to the randomized entities as *work sites* across both companies.

Work sites were randomly assigned to either intervention or usual practice conditions using a biased coin adaptive randomization technique (Frane, 1998) as adapted to group randomization. Random group assignment enhances internal validity while minimizing the opportunity for contamination. Usual practice was chosen as the control to directly address whether the intervention produced better outcomes than current practice. The intervention was designed to increase supervisor and coworker support for work-family integration and to increase employees' perception of control over their work time. The multifaceted intervention was delivered through supervisory training that included strategies to increase supervisor support and facilitate employees' control over work time, in conjunction with work redesign activities that helped employees and supervisors identify ways to increase employees' control over work time while meeting business goals.

Challenge 1. Balancing Organizational and Pragmatic Scientific Requirements

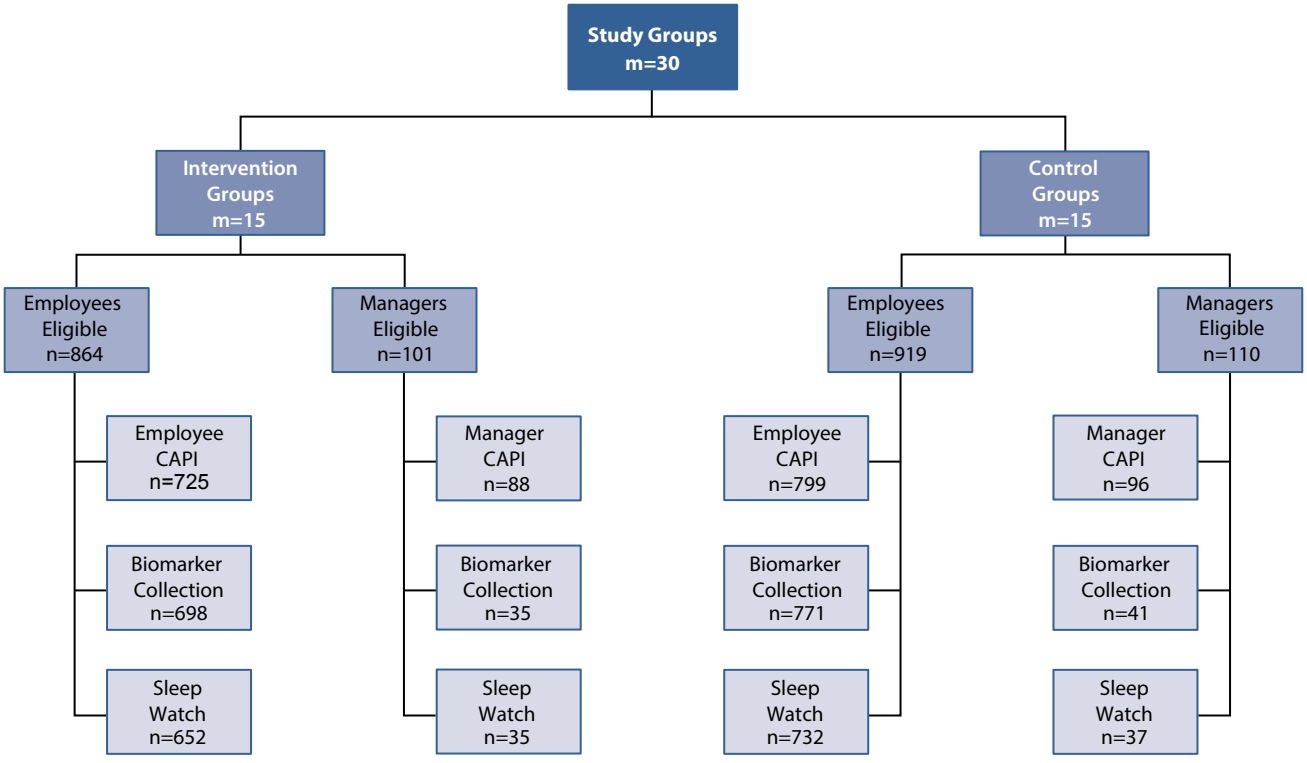
Our initial challenge was to conduct experimental research, specifically a group-randomized trial, in changing organizations and to integrate organizational and pragmatic needs for balance across conditions on some factors with scientific requirements. This challenge had implications for recruitment, statistical power, and randomization.

Recruitment

Figures 2 through 5 present the number of work sites, managers, employees, spouses, and children recruited into the WFHS. Recruitment for the WFHS started with selecting target industries, companies in the information technology and extended health care sectors, to provide diversity in employee job level, job type, and job classification. The information technology company represented a higher-wage, white collar workforce, whereas the extended care company represented a lower-wage, hourly workforce. Examination of the intervention in two diverse workforces will ultimately lead to a greater ability to generalize findings to other sectors.

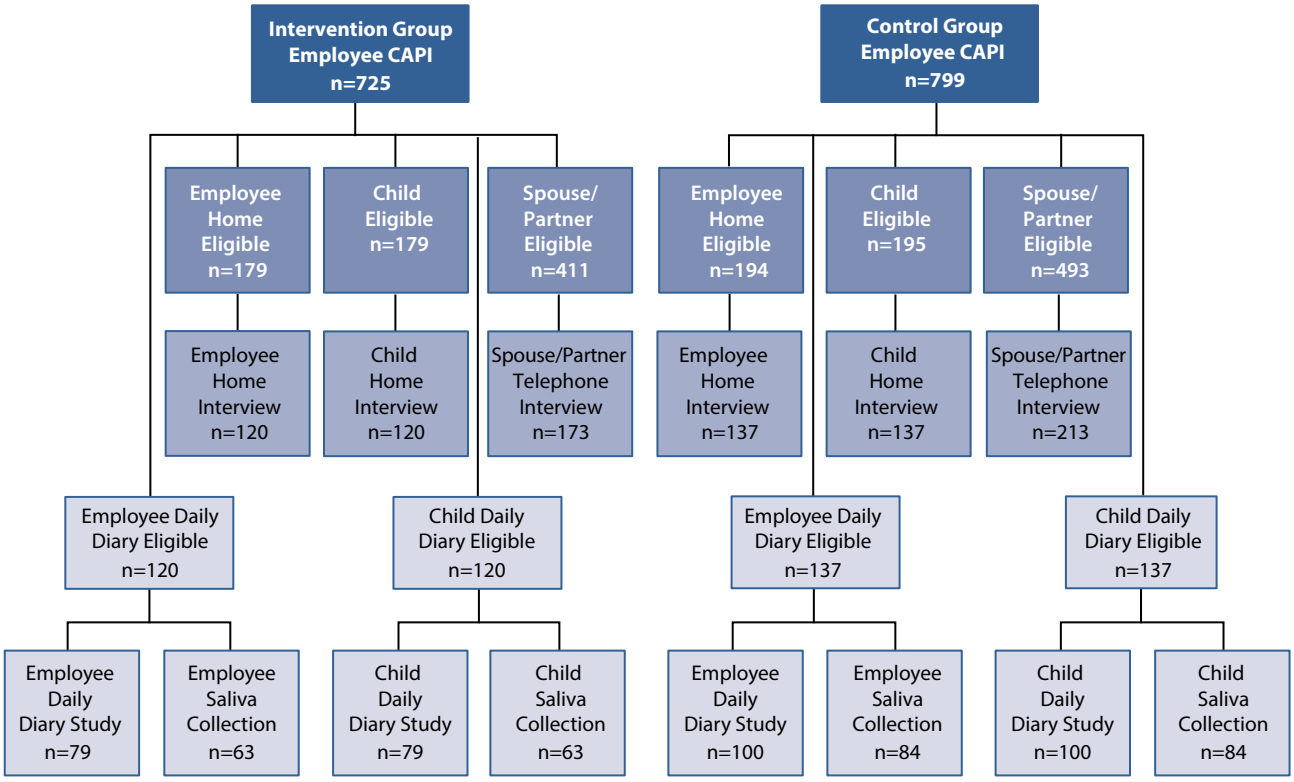
Previous research including WFHN Phase 1 studies suggests that these types of industries are good targets for an intervention to reduce work-family conflict because of the high job demands and low schedule control typical in these industries, resulting in high potential for work-family conflict (Bailyn, Collins, & Song, 2007; Berkman, Buxton, Ertel, & Okechukwu, 2010; Hammer et al., 2011; Kelly, Moen, & Tranby, 2011; Moen, Kelly, & Hill, 2011). Companies were selected that could meet the minimum requirements for this study design: multiple work sites sufficient to support random assignment, with appropriate numbers of employees within each site. Final decision criteria included geographic proximity to minimize study personnel travel distance between locations, site and workforce stability to support the research for the study duration, and specific endorsement from the company partner leadership to support all research activities.

Figure 2. Company 1 baseline work site data collection



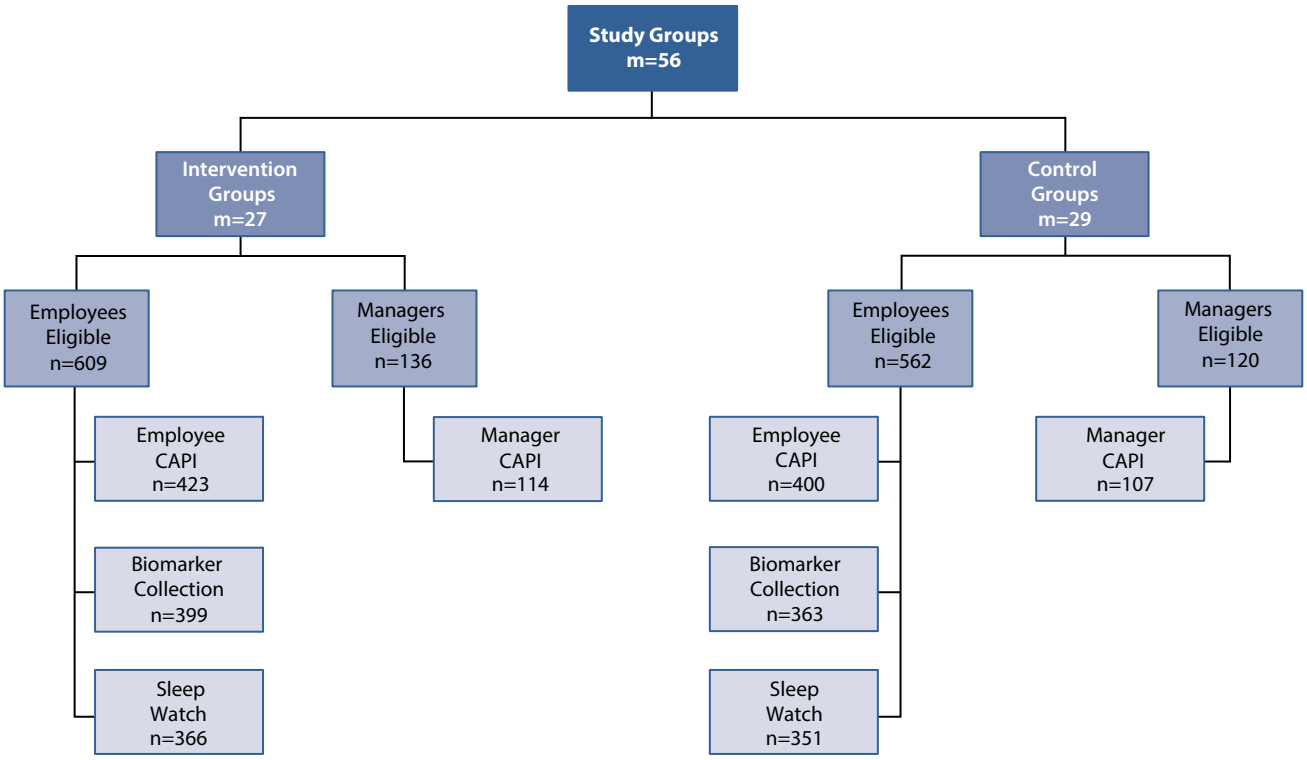
Note: m = number of groups; n = number of individuals; CAPI = computer-assisted personal interview.

Figure 3. Company 1 baseline family data collection



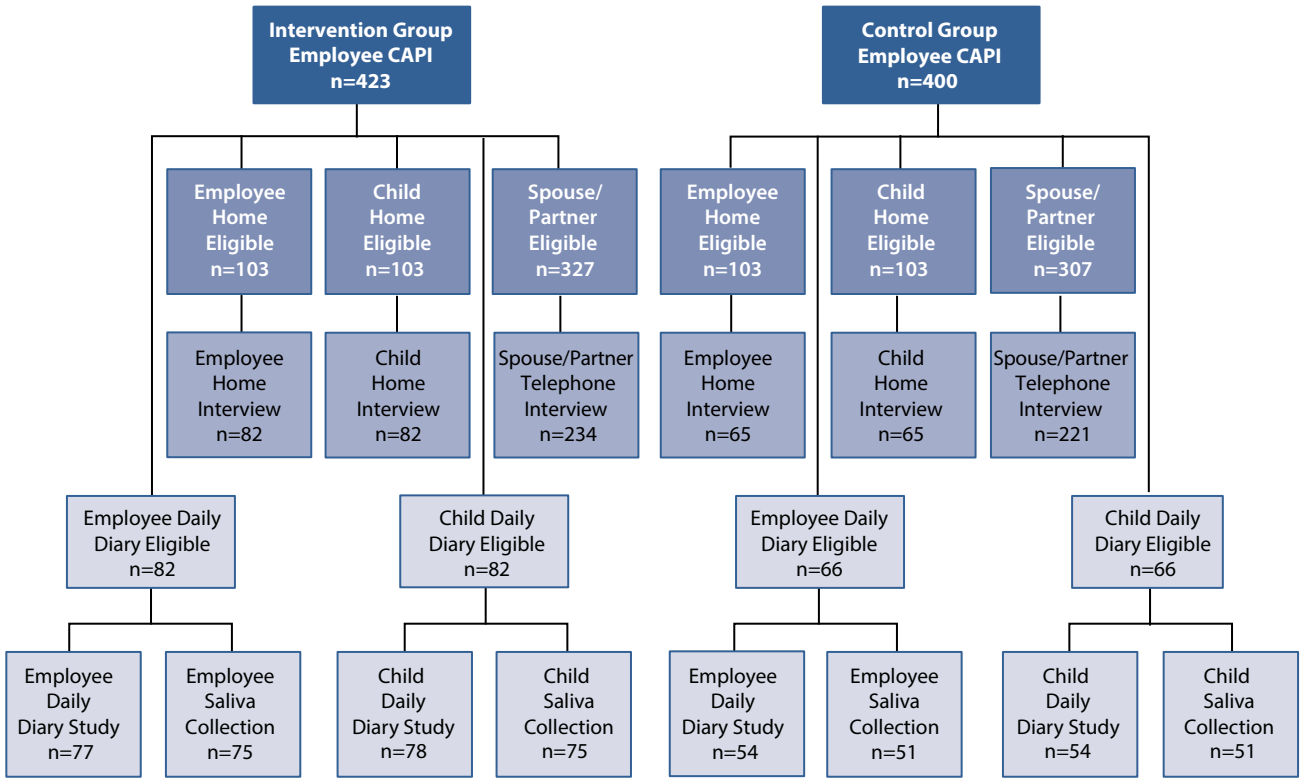
Note: n = number of individuals; CAPI = computer-assisted personal interview.

Figure 4. Company 2 baseline work site data collection



Note: m = number of groups; n = number of individuals; CAPI = computer-assisted personal interview.

Figure 5. Company 2 baseline family data collection



Note: n = number of individuals; CAPI = computer-assisted personal interview.

After selecting the partner companies, work sites were recruited and randomized. Selection criteria for work sites included size, geographic proximity to and work-flow overlap with other work sites, and ability to support data collection and intervention delivery logistically.

Because Company 2 (in the information technology industry) has a centralized organizational structure, recruitment involved discussions and agreements with company leadership spanning all work sites in this division. Managers of work teams in a particular work site were briefed about their site's participation, with the presumption that their site would participate in the study and in the intervention if randomized to that condition. A single site whose employees are represented by collective bargaining agreements was excluded from the study because of concerns that the site would not be able to implement the intervention if randomized to that condition because elements of the intervention might conflict with existing work rules.

Company 1 (extended care) has a less centralized organizational structure; corporate representatives introduced the study to the top administrators of a particular work site (a geographically distinct work location), and study representatives then worked to recruit that site at the administrative and employee levels.

Employees and supervisors in Company 1 (Figure 2) were eligible to participate if they were normally scheduled to work 22 or more hours per week in direct patient care, and they worked on the day or evening shifts (thus excluding night shift workers). Nightshift workers were excluded because of logistical challenges scheduling in-person interviews with these employees, and because the nature of the intervention as delivered to, and acted upon, by busy teams of day workers in extended care facilities would be fundamentally different from such a work redesign in nightshift workers on relatively skeleton crews while the residents were asleep. Employees and supervisors in Company 2 (information technology; Figure 4)

were eligible to participate if they were located in the two cities where data collection occurred and were classified as employees, rather than independent contractors, of the company. A small number of employees in the United States for 1 year on a specialized training visa were excluded from the study population.

All spouses and cohabiting partners of eligible employees were eligible for study participation (Figures 3 and 5). Child participants (ages 9 to 17 years) included biological, step-, and adopted children who lived with the employee for 4 or more days per week. If a household had more than one age-eligible child, the child closest to age 13 was selected. The WFHS focused on youth ages 9 to 17 because this developmental period is a time of dramatic change, with unique demands on parents that may exacerbate work-family conflict. Also, youth in this age group are able to provide more reliable and nuanced reports of family experiences than are younger children.

Power and Sample Size Consideration

Initial power calculations were conducted prior to recruiting company partners to inform recruitment decisions. The most proximal outcome of the proposed intervention is the perceived work-family conflict of the employee. For this reason, we powered the study to ensure that we can identify the effect of the intervention on work-family conflict among employees at $\alpha = 0.05$ with power of 0.8. Using the formulas presented in Murray (1998) and data collected from Phase 1 of the WFHN (Kelly et al., 2011), we estimated that we needed a minimum of 15 work sites per condition and 20 employees per site at each time point. We also calculated power for self-reported sleep outcomes and for a composite coronary heart disease risk score based on biomarker data (Berkman et al., 2010). All outcomes were powered to at least 0.8 assuming 15 work sites per condition and 20 employees per work site.

After recruiting partnering companies and associated work sites and obtaining funding, we performed additional power calculations using the actual number of work sites and employees of our company partners. Most importantly, we wanted to understand the impact of varying work site size on statistical power because our initial power calculations assumed a constant group size across randomized sites. Power calculations were performed using an adaptable spreadsheet so that the values of key parameters could be changed easily to evaluate power under a variety of assumptions.

We considered three scenarios in these revised power calculations: a baseline scenario that uses data from Phase 1 studies to calculate expected effect sizes, variances, and intracluster correlations; a high-power scenario with larger effect sizes and smaller variances and intracluster correlations; and a low-power scenario with smaller effect sizes and larger variances and intracluster correlations. For both industries, we found that our expected recruitment would yield sufficient power for work-family conflict and the composite coronary heart disease risk score under the baseline and high-power scenarios and that the sleep outcome had sufficient power in all scenarios.

Randomization Design

Initially, the WFHS design was intended to assign work sites to intervention or usual practice (UP) conditions using a 1:1 allocation rule, with simple, a priori group-level randomization. This randomization approach was based on the assumption that all eligible work sites would be known a priori, would all have approximately the same number of employees, and could begin study activities at the discretion of the WFHN. After finalizing company partners and identifying the work sites to be randomized, it became clear that this assumption was invalid for reasons that varied by company. Throughout, it was thus critical to remain responsive to the needs and requirements of our study partners to collect data and maintain that partnering relationship. This study is of work and family flexibility in many respects, but extremes of flexibility were also required of the WFHN to adapt procedures and expectations to the realities of company partners in competitive industries.

Work sites in Company 1 were extended care facilities and varied substantially in the number of employees per work site, ranging from 34 to 117; in the state regulatory environments in which they operate; and in their expected retention rate of employees over the course of the study—all factors that study

investigators felt were essential to balance across study conditions. Furthermore, the Company 1 leadership advised us that results from a study within a single state or size range of facility would be less convincing to future adopters, even if the study outcome was favorable. Therefore, we realized the need to match intervention and UP work sites in Company 1 based on the number of employees, state, and retention rate. We also learned that work sites were unable to commit to an intervention or data collection timeline far in advance because of rolling state audits during which on-site data collection would be untenable. Therefore, we randomized work sites on a flow basis while attempting to ensure balance on key characteristics.

To balance study conditions across multiple criteria while allowing randomization on a flow basis, we selected an adaptive randomization approach. Adaptive randomization allowed the study team to bias the randomization odds at each randomization of available and eligible sites so that overall balance was maintained across conditions on the selected criteria. Adaptive randomization also allowed for a high degree of flexibility in the randomization process. Work sites were randomized into a condition as they were ready to begin data collection. This just-in-time randomization reduced the lag between randomization and data collection, which in turn reduced the likelihood of a randomized site dropping out before the first wave of data collection began. Adaptive randomization also allowed the study to use logistical concerns, such as geographical proximity and readiness to start data collection, as blocking factors without further complicating the design of the randomization.

In Company 2, a telecommunications company, organizational representatives and our own formative work suggested that study findings would be discounted—viewed as irrelevant to an employee's or executive's own situation—if all or most of the sites that received the intervention were from a single job function, a single vice president organization, or a single location. Therefore, we decided that intervention and UP work sites should be balanced on job function, vice president, and the number of employees in each of the two geographic areas from which Company 2 worksites were recruited.

To achieve this balance, we initially used a stratified randomization approach in which work sites were assigned to strata defined on these characteristics. A priori randomization to the intervention and UP conditions would occur within each stratum, with an equal number of sites within that stratum being assigned to each condition. This method of randomization would ensure balance across the stratifying characteristics. Once randomized, work sites were grouped into bundles that would roll out the data collection and intervention process over time. The bundles were created to include about 100 total employees per bundle, with roughly 50 intervention employees and 50 UP employees. A timeline by which bundles would move through data collection and intervention was created so that the employees under a vice president or in a specific geographic location would move through the process together.

When the initial stratified randomization design was chosen, we thought there would not be significant changes in site structure over the course of the study period. Site membership might change somewhat as employees were hired, retired, or switched sites, but the sites as identifiable entities were thought to be quite stable. However, several changes in site structure related to organizational restructuring occurred just after we completed data collection from the pilot bundle. Because of this early experience, the study team was concerned that there might be significant changes in site structure during the course of data collection rollout. Therefore, an alternative randomization method was needed to give the study the flexibility to handle the shifting nature of sites.

The new randomization scheme needed to balance the criteria identified in the stratified randomization scheme: the site's job function (as core or support), vice president, and number of employees. The new scheme also needed to allow for the same general rollout plan that the intervention team had identified, as the data collection rollout had been planned around the dates of key work milestones for teams within sites and those teams' management had already been informed of the rollout schedule.

An adaptive randomization scheme, similar to the one already being employed in Company 1, was chosen. Adaptive randomization allowed sites to be randomized near the beginning of their data collection instead of months in advance, so that randomization could be based on current work site characteristics. Adaptive randomization allowed the sites to be balanced across all previously identified criteria. Conveniently, the adaptive randomization process (described in detail below) required that the first four sites be assigned to study condition via simple randomization, and the first two sites had already been assigned this way (within their cluster). Thus, we were able to integrate their previous randomization without additional design or analytical complications.

Randomization Implementation

To implement the adaptive randomization method, we modified a biased coin randomization technique (Frane, 1998) for use with group randomization as follows. Each work site was hypothetically assigned to the intervention condition, and the null hypothesis of balance across study conditions was tested separately for each randomization criterion. Intuitively, the testing procedure assessed whether assigning a given work site to the intervention condition caused imbalance in the conditions, given the prior study assignments. A *t*-test was performed for continuous criteria, and a Fisher's exact F test was performed for categorical criteria. The *p* value for each test was recorded as p_i (one for each criterion). Each work site was then hypothetically reassigned to UP, the tests were repeated, and their corresponding *p* values were recorded as p_{up}. Once all tests had been performed, the lowest overall *p* value indicated the single criterion and study condition assignment that would create the most imbalance in study assignment. Using the *p* values for this criterion, the probability of assignment to the intervention condition is $p_i/(p_i + p_{up})$, whereas the probability of assignment to UP is $p_{up}/(p_i + p_{up}) = 1 - p_i/(p_i + p_{up})$. This procedure was then repeated for each work site to be randomized.

A hypothetical example for Company 2 is shown in Table 1. In the example, if the given work site were assigned to the intervention condition, then a test of balance across conditions for job function would yield a *p* value of 0.451; if the same work site was assigned to the UP condition, then a test of balance for job function would yield a *p* value of 0.878. For each assignment, the minimum *p* values are noted, and the overall lowest *p* value is 0.095, indicating near statistically significant imbalance for vice president across sites if the work site were assigned to intervention. In this example, then, the probability that the work site would be assigned to the intervention condition is

$$0.095/(0.095 + 0.554) = 0.146,$$

and the probability that the work site would be assigned to the UP condition is

$$0.554/(0.095 + 0.554) = 0.854.$$

Table 1. Hypothetical biased coin randomization

Randomization Factor	Intervention	Usual Practice
Job function	0.451	0.878
Number of employees	0.615	0.311
Vice president	0.095	0.554
Minimum *p* value	0.095	0.311
Randomization probability	0.146	0.854

When a number of work sites were ready to be randomized for data collection and intervention delivery, they were grouped into randomization blocks of two to eight work sites that were randomized at the same time. Information for the work sites in the randomization block was entered into the randomization algorithm implemented in Stata/SE 11 (StataCorp LP, College Station, Texas, USA). The adaptive randomization method randomized one work site within the block at a time, meaning that the algorithm was sensitive to the ordering of sites within a block. To account for this, the algorithm's first step was to randomly order the work sites within the block using Stata's pseudo-random number generator. The first four work sites within each company were randomized using simple randomization, and all subsequent work sites were randomized using the adaptive randomization method.

One additional constraint was placed on the randomization process: the number of work sites assigned to each condition must be equal within a block. For example, consider a randomization block containing four work sites. If the first two were assigned to the intervention condition via the adaptive randomization process described above, the remaining two would be assigned automatically to the UP condition without any further randomization within that block. Similarly, if two of the first three were assigned to the UP condition and one to the intervention condition, the final work site would be assigned automatically to the intervention condition. This process maintained an overall balance between the number of sites in each condition. Some imbalance in the number of sites assigned to each condition was still possible because of blocks that had an odd number of work sites to be randomized, but this was rare, so no attempt was made to force balance in such cases.

The decision to use adaptive randomization carried with it two potential drawbacks. The first was the need to include the randomization covariates and blocking indicator variables in analysis. The inclusion of these variables lowers the total number of degrees of freedom within the model. Second, some authors recommend using permutation tests as the primary form of analysis for adaptively randomized data. We chose the biased coin approach because prior literature suggested that statistical modeling could be used for analyses (Frane, 1998). To confirm that modeling approaches were appropriate given the biased coin group randomization, we conducted a Monte Carlo simulation analysis to assess potential bias and Type I error rates of model-based treatment effect estimates. The Monte Carlo analysis used parameters based on variances and intracluster correlations found in initial baseline data from Company 2 and effect sizes from Phase 1 work. The Monte Carlo work demonstrated that model-based estimates of treatment effects, when randomization covariates and blocking indicators were included in the model, were unbiased and had nominal Type I error rates.

Challenge 2. Collecting Meaningful Data for a Variety of Stakeholders

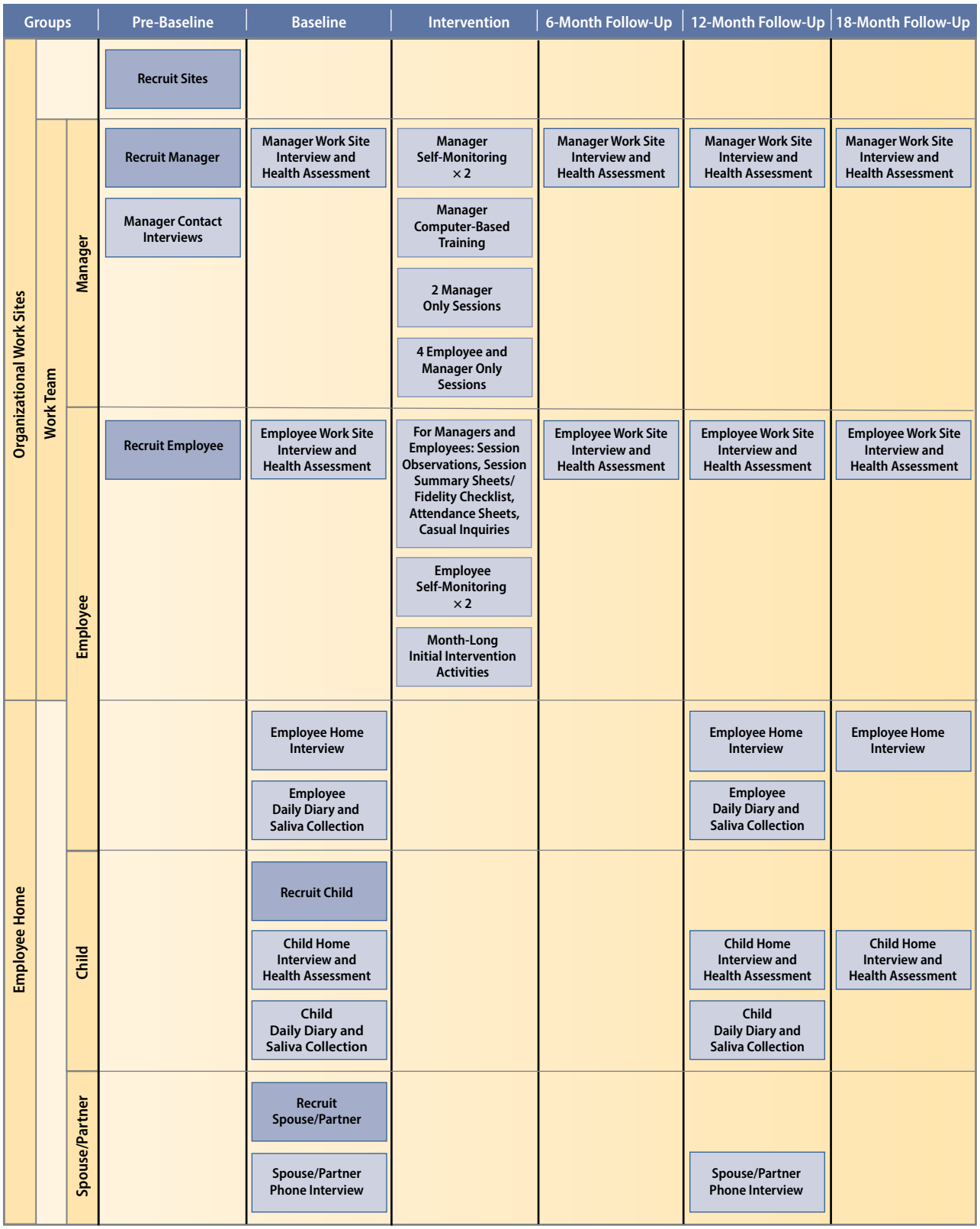
The second challenge was to collect data that were meaningful for a variety of different stakeholders—researchers from different disciplines, policymakers, employees, family members, participating employers, and potential adopters—and to motivate all stakeholders to share information as requested over time. Further complicating data collection was the clear need to collect data at many different levels given the need to conceptualize work-family conflict as a multilevel phenomenon (Bhave et al., 2010; Bliese & Jex, 2002). The following sections describe our decisions for data collection procedures and methods.

Data Collection

Figure 6 illustrates the data collection flow at each work site involved in the WFHN Phase 2 effectiveness study, the WFHS. Trained field interviewers administered face-to-face interviews with work site supervising managers, employees, and children and conducted telephone interviews with employees' spouses/cohabiting partners. Data were collected from employees and their supervising managers at intervention and UP work sites at baseline and 6, 12, and 18 months post-baseline. Employee and supervisor data collection at the worksite included a 60-minute interview and a 30-minute health assessment consisting of blood pressure, height, weight, collection of blood spots for future biomarker assays, and distribution of a wrist actigraph for collection of wrist activity data from which sleep patterns could be estimated. Employees received up to $60 for completing all work site components at each wave.

At baseline and 12 months, additional data were collected from the employee and the employee's age-eligible child. If the employee had an age-eligible child, the employee was asked to complete a 25-minute home interview and then received a $30 incentive. Children, with parental consent and their assent, completed a 60-minute home interview and health assessment and received $50. The child health assessment included blood pressure, height, and weight. Spouses/partners completed a 30-minute telephone interview and received a $20 check by mail.

Figure 6. Intervention effectiveness study data collection flow per work site



Employees and children received information from their health assessment. Interviewers recorded body mass index, blood pressure, and, for employees, glycosylated hemoglobin (HbA_{1c}) levels on a feedback card that had an interpretation of the readings and recommended guidelines. Blood pressure readings were collected with a wrist blood pressure monitor (Omron HEM-637, Omron Healthcare, Bannockburn, Illinois). Height was measured using a stadiometer capable of measurements up to 205 cm (SECA 213/214 stadiometers, Seca North America, Hanover, MD, USA), and weight was measured using a scale capable of weighing respondents up to 180 kg (Health-O-Meter 800KL, Jarden Corporation, Rye, New York, USA). Up to five blood spots were collected on special filter paper with a six-character alpha-numeric barcode (903 Protein Saver Paper, GE Healthcare Bio-Sciences Corp., Piscataway, New Jersey, USA), air-dried, and then sealed in a plastic bag for room-temperature shipment with desiccant for eventual storage at −86°C until assay. Interviewers also collected a small (1 microliter) blood droplet in a microtube for immediate measurement of HbA_{1c} levels (indicative of the last 2 months' average blood glucose) using a point-of-care device (DCA Vantage Analyzer, Siemens Healthcare Diagnostics, Frimley, Camberley, UK).

Finally, employees were asked to wear a 30-gram actigraph with on-wrist detection and a watch face (Spectrum, Philips/Respironics, Murrysville, Pennsylvania, USA) to discretely record wrist movement activity patterns and ambient light exposure for 1 week. Actigraphy source data were scored using Actiware sleep software provided by the manufacturer.

Recruitment materials emphasized the value of the research for employees and for the employing organization, as well as for scientific knowledge more broadly. Trained WFHS site managers introduced the study to managers and employees at each work site and then handled questions during the data collection period. As expected in work site studies, it was important to emphasize the independence of the research team and the strict confidentiality of individual data. At the same time, employees were often pleased that their organization was participating in the study because they hoped findings would lead to improvements in local policies or practices.

Measures

Tables 2 through 5 summarize the measures collected. Each table corresponds to a different data collection effort, as shown in Figure 6: employee and manager work site interviews (Table 2), employee home interviews (Table 3), spouse telephone interviews (Table 4), and child home interviews (Table 5). The employee and manager work site interview measures are combined in Table 2 because of the substantial overlap in their content.

Within each table, measures are categorized as either outcomes/mediators (i.e., variables that are predicted to be affected by the intervention) or moderators/confounds. Across all levels, primary outcomes include work-family conflict, cardiometabolic risk, sleep, psychological distress, family processes, and organizational outcomes. The first column of each table presents the conceptual construct being measured, and the second column presents source studies or bibliographic references for items measuring those constructs.

Table 2. Employee and manager work site interview measures

Measure	Source/Adapted From
Outcomes/Mediators	
Work-family conflict	
Organization work-family climate	Kossek, 2001
Time adequacy	Van Horn, Bellis, & Snyder, 2001
Work-family positive spillover	Hanson, Hammer, & Colton, 2006
Work-to-family conflict	Netemeyer, Boles, & McMurrian, 1996
Psychosocial work environment	
Control over work time	Thomas & Ganster, 1995
Family-supportive supervisor behaviors	Hammer, Kossek, Yragwi, Bodner, & Hanson, 2009
Job control	Karasek et al., 1998
Job demands	Karasek et al., 1998
Low-value work	Rizzo, House, & Lirtzman, 1970
Obligation to come to work when sick	Created for WFHN
Organizational citizenship	Lambert, 2000
Role clarity	Cammann, Fichman, Jenkins, & Klesh, 1983
Task interdependence	Pearce & Gregersen, 1991
Physical health	
Cardiometabolic disease risk	Modified Framingham risk factor score; Berkman et al., 2010; Wilson et al., 1998
Chronic conditions	Seeman & Berkman, 1988; Wilson et al., 1998
Chronic inflammation (C-reactive protein)	McDade, Williams, & Snodgrass, 2007
Diabetes risk (HbA1c)	Edelman et al., 2004; Norberg et al., 2006
Functional disability (employee only)	Garrat, Schmidt, Mackintosh, & Fitzpatrick, 2002; Turner-Bowker, Bartley, & Ware, 2002
Health behaviors	Bray et al., 2007; French, Harnack, Toomey, & Hannan, 2007; NCHS, 2005
Stress-mediated immunosuppression (Epstein-Barr virus antibody titers)	McDade et al., 2007
Sleep	
Sleep apnea risk	Adapted from Maislin et al., 1995
Sleep duration and disruption (wrist actigraphy)	Ancoli-Israel et al., 2003; Morgenthaler et al., 2007; Ertel, Berkman, & Buxton, 2011
Sleep quality	Adapted from PSQI (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989); Buxton et al., 2009; Buxton et al., 2012
Psychological distress	
Non-specific psychological distress K6 scale	Kessler, Barker, et al., 2003; Mroczek & Kolarz, 1998
Perceived stress (employee only)	Cohen, Kamarck, & Mermelstein, 1983; Cohen & Williamson, 1991
Social support	Seeman & Berkman, 1988
Family processes	
Marriage/life partner expectations	Created for WFHN
Parental knowledge	Stattin & Kerr, 2000
Parent-child conflict	Harris, 1992; Smetana, 1988
Parenthood expectations	Created for WFHN
Parenting	Arnold, O'Leary, Wolff, & Acker, 1993

Table 2. Employee and manager work site interview measures *(continued)*

Measure	Source/Adapted From
Family processes *(continued)*	
Spouse support and strain	Grzywacz & Marks, 1999, 2000; Schuster, Kessler, & Aseltine, 1990; Walen & Lachman, 2000
Time with child(ren)	Created for WFHN
Organizational outcomes	
Accidents and injuries	Hemingway & Smith, 1999
Burnout	Maslach & Jackson, 1986
Health care utilization	Bray et al., 2007
Intention to quit	Boroff & Lewin, 1997
Job satisfaction	Cammann et al., 1983
Job security	Brim, Ryff, & Kessler, 2004
Productivity	Kessler, Barber, et al., 2003
Safety compliance	Neal, Griffin, & Hart, 2000
Moderators/Confounds	
Basic demographics	
Gender	
Age	
Education	
Race/ethnicity/nativity	
Work characteristics	
Commuting time	
Job title	
Multiple jobs	
Night/weekend work	
Number of supervisees	
Schedule	
Telecommuting	
Tenure	
Family demographics	
Child roster	
Spouse/partner demographics	
Time spent caring for other adults	
Income adequacy	Neal & Hammer, 2007
Adaptability/readiness for change (manager only)	Cunningham et al., 2002; Prochaska et al., 1994
Leadership style (manager only)	Avolio, Bass, & Jung, 1999
Management trust scale (manager only)	Cook & Wall, 1980
Manager views of flexible work arrangements on productivity (manager only)	Kossek, Barber, & Winters, 1999

Table 3. Employee home interview measures

Measure	Source/Adapted From
Outcomes/Mediators	
Psychosocial work environment	
Family specific coworker support	Hammer et al., 2009
General coworker support	Caplan, Cobb, French, Van Harrison, & Pineau, 1975
Supervisor support	Hammer et al., 2009
Team cohesion	Podsakoff & MacKenzie, 1994
Psychological distress	
Daily discrimination	Williams, Yu, Jackson, & Anderson, 1997
Family processes	
Behavior problems index (BPI)	Achenbach & Edelbrock, 1983; Graham & Rutter, 1968; Kellam, Branch, Agrawal, & Ensminger, 1975; Mott, Baker, Ball, Keck, & Lenhart, 1998; Peterson & Zill, 1986; Rutter, Tizard, & Whitmore, 1970
Child care arrangements	Created for WFHN
Elder care	Neal & Hammer, 1998
Parental solicitation and disclosure	Stattin & Kerr, 2000
Parental stress	Stephens & Townsend, 1997
Parent-child warmth and acceptance	Schaefer, 1965; Schluderman & Schluderman, 1970; Schwarz, Barton-Henry, & Pruzinsky, 1985
Preparation for bias	Hughes & Chen, 1997
Relationship satisfaction	Huston, McHale, & Crouter, 1997
Child adjustment	Dotterer, McHale, & Crouter, 2009
School situation (employee report on child)	Created for WFHN

Table 4. Spouse telephone interview measures

Measure	Source/Adapted From
Outcomes/Mediators	
Work-family conflict	
Time adequacy	Van Horn et al., 2001
Time with child(ren)	Created for WFHN
Work characteristics	Job title, schedule, multiple jobs, hours worked
Work schedule flexibility	Created for WFHN
Work-family positive spillover	Hanson, Hammer, & Colton, 2006
Work-to-family conflict	Netemeyer et al., 1996
Work-to-family conflict (spouse report on employee)	Netemeyer et al., 1996
Physical health	
Health behaviors	Bray et al., 2007; French, Harnack, Toomey, & Hannan, 2007; NCHS, 2005
Health behaviors (spouse report on employee)	Bray et al., 2007; French et al., 2007; NCHS, 2005
Physical health symptoms	Almeida, 1998; Charles & Almeida, 2006; Larsen & Kasimatis, 1991
Physical health symptoms (spouse report on child)	Almeida, 1998; Larsen & Kasimatis, 1991
Sleep	
Sleep apnea (spouse report on employee)	Maislin et al., 1995
Sleep quality	Buysse et al., 1989
Psychological distress	
Perceived stress	Cohen et al., 1983; Cohen & Williamson, 1991
Positive and negative affect (spouse report on child)	Laurent et al., 1999; Watson, Clark, & Tellegen, 1988
Psychological distress	Kessler, Barker, et al., 2003; Mroczek & Kolarz, 1998
Family processes	
Co-parenting	Margolin, Gordis, & John, 2001
Household chaos	Matheny, Wachs, Ludwig, & Phillips, 1995
Parental knowledge	Stattin & Kerr, 2000
Parent-child conflict	Smetana, 1998; Harris, 1992
Parenthood expectations	Created for WFHN
Parenting	Arnold et al., 1993
Relationship satisfaction	Huston et al., 1997
Spouse support and strain	Grzywacz & Marks, 1999; Schuster et al., 1990; Walen & Lachman, 2000
Time spent caring for adults	Created for WFHN
Organizational outcomes	
Insurance and hospital visits	Bray et al., 2007
Job security	Brim et al., 2004
Productivity	Kessler, Barber, et al., 2003
Moderators/Confounds	
Basic demographics	
Gender	
Age	
Socioeconomic status	
Race/ethnicity/nativity	
Income adequacy	Neal & Hammer, 2007

Table 5. Child home interview measures

Measure	Source/Adapted From
Outcomes/Mediators	
Work-family conflict	
School and work situation	Created for WFHN
Time adequacy	Van Horn et al., 2001
Time use	McHale, Crouter, & Tucker, 2001
Physical health	
Physical health symptoms	Almeida, 1998; Charles & Almeida, 2006; Larsen & Kasimatis, 1991
Sleep	
Sleep duration and quality	Buysse et al., 1989
Psychological distress	
Depressive symptoms	Kovacs, 2001
Psychological well-being	Keyes, 2006
Risky behaviors	Dishion, Patterson, Stoolmiller, & Skinner, 1991; Eccles & Barber, 1990; Huizinga, Ebensen, & Weiher, 1991; Mason, Cauce, Gonzales, & Hiraga, 1994
Family processes	
Household chaos	Matheny et al., 1995
Lax discipline	Schaefer, 1965; Schluderman & Schluderman, 1970; Schwarz et al., 1985
Parental involvement in school	Phillips Smith et al., 1997
Parental knowledge	Stattin & Kerr, 2000
Parent-child conflict	Smetana, 1998; Harris, 1992
Parent-child time together	McHale et al., 2001
Parent-child warmth and acceptance	Schaefer, 1965; Schluderman & Schluderman, 1970; Schwarz et al., 1985
Routines	Jensen, James, Boyce, & Hartnell, 1983
School bonding	Libby, 2004; Dotterer, McHale, & Crouter, 2007; Fine, 1991; McNeely, 2005; Voelkl, 1997
Social competence	Search Institute, 2001
Solicitation and disclosure	Stattin & Kerr, 2000
Moderators/Confounds	
Economic insecurity	Created for WFHN
Pubertal development	Petersen, Crockett, Richards, & Boxer, 1988

Challenge 3. Establishing Broad Analysis Plans

The third challenge was to identify analysis approaches broad enough to meet the needs of a transdisciplinary team and allow examination of a wide variety of outcomes; integrated enough to facilitate the accumulation of knowledge across the project; and rigorous enough to convince scholars across a broad array of disciplines, including disciplines that expect a priori analysis plans. This paper presents the overarching framework used by WFHN researchers when testing specific hypotheses. The exact hypotheses to be tested and their associated analytic methods will be presented in future papers.

The process for determining the preferred analytic approach began with a presentation by the WFHN Data and Methods Coordinating Center on analyses appropriate for multilevel data. While experience with multilevel analyses varied across the WFHN investigators, the group-randomized design of the WFHS and the complex organizational structures of the partnering companies required some form of multilevel analysis. Furthermore, multilevel modeling approaches are consistent with theory and emerging practice in multiple disciplines.

For example, sociologists, social epidemiologists, demographers, and economists are increasingly modeling the effects of neighborhoods or other aggregated social settings on individual behavior and health risks; organizational scholars from psychology and management are more consistently analyzing employees nested in teams or work organizations; family scholars have long studied dyads and other family units; and almost all social sciences now recognize the analysis of multiple time points within the same individual as a special case of multilevel data analysis.

A key consideration in any multilevel analysis is deciding between random effect (also known as subject-specific) and population-averaged analyses. Random effect analyses are appropriate when the researcher is interested in changes or effects among the individual members of a group. Population-averaged analyses are appropriate when the researcher is primarily interested in effects on population-level parameters, usually the mean. Although often very similar in magnitude, and in some cases identical, the two effects represent different levels of inference and therefore lead to different analysis methods.

Because the WFHN is interested in the effects of the intervention on individual employees and their families, we chose random effect analyses as the primary analytic method. Random effect analyses allow us to examine both individual-level and site-level effects, whereas population-averaged analyses typically do not allow examination of individual-level effects.

Furthermore, random effects models facilitate the investigation of multilevel moderation hypotheses and can accommodate the movement of employees across work teams. We chose generalized linear mixed models (GLMM) based on recommendations in the literature on group randomized designs (Donner & Klar, 2004; Murray, 2004; Varnell, Murray, Janega, & Blitstein, 2004) and because these methods overlap with the hierarchical linear models with which many WFHN members were already familiar. Specifically, GLMMs of the following form are used to assess the effect of the intervention on outcomes (bold font indicates vector notation):

$$Y_{ij:k:l} = f(\beta_0 + \beta_1 C_l + \beta_2 T_j + \beta_3 T_j C_{jl} + \boldsymbol{\beta}_4 \mathbf{X}_{ij:k:l} + \boldsymbol{\beta}_5 \mathbf{RAND}_k + \boldsymbol{\gamma}_0 \mathbf{G}_{k:l} + \boldsymbol{\gamma}_1 \mathbf{M}_{i:k:l} + \boldsymbol{\gamma}_2 \mathbf{TG}_{jk:l}) + \varepsilon_{ij:k:l} \quad (1)$$

$Y_{ij:k:l}$ is the outcome for person i observed at time j, nested within site k, which is in condition l; $f(\cdot)$ is a link function; and $\varepsilon_{ij:k:l}$ is an iid error or residual. Specifying both $f(\cdot)$ and the distribution of $\varepsilon_{ij:k:l}$ yields various models appropriate for a variety of outcomes. The βs are fixed-effect parameters to be estimated, and the γs are random-effect parameters (i.e., variance components) to be estimated. C_l is a dichotomous variable indicating membership in the intervention condition; T_j is a dichotomous variable indicating the jth time point; $T_j C_{jl}$ is the interaction between the study condition and time indicator variables; $\mathbf{X}_{ij:k:l}$ is a vector of demographic and other potential confounds; and $\mathbf{RAND}_k$ is a vector of randomization factors including the site-level variables used in the biased coin algorithm and any blocking factors. $\mathbf{G}_{k:l}$ is a vector of indicator variables for site membership; $\mathbf{M}_{i:k:l}$ is a vector of indicator variables for each individual; and $\mathbf{TG}_{jk:l}$ is a vector of interactions

between time points and site membership. An advantage of GLMM is that the model can be easily extended to allow for multiple levels of clustering, such as work teams within work sites. Given the specification of the fixed effects, β_3 captures the effect of the intervention at that follow-up time point (Murray, 1998).

Equation 1 can be used to examine outcomes at any level simply by redefining *i* and *k*. If *i* is used to index employees and *k* to index work teams, then equation 1 can be used to assess the effects of the intervention on employee-level outcomes within the work site context. If *k* is used to index families, however, then *i* can be used to index individual family members and employee, spouse, or child outcomes can be explored within the family context. Although a GLMM framework is used to facilitate an understanding of individual-level behaviors, WFHN analyses usually will not attempt to draw inferences about the random effects specified in equation 1. Rather, the GLMM is used to obtain valid standard errors for the fixed effects in equation 1.

Potential moderators of the intervention effect on work-family conflict can also be incorporated within the GLMM framework. To test the moderating effects of specific factors on the effect of the intervention on work-family conflict, we include interactions between the hypothesized moderator and the design variables included in equation 1. Thus, for moderator W_{ij}, we estimate the following GLMM:

$$\begin{aligned} Y_{ij:k:l} = {} & \beta_0 + \beta_1 C_l + \beta_2 T_j + \beta_3 T_j C_{jl} + \beta_4 C_l W_{ij} + \beta_5 T_j W_{ij} \\ & + \beta_6 T_j C_{jl} W_{ij} + \beta_7 W_{ij} + \boldsymbol{\beta}_8 \mathbf{X}_{ij:k:l} + \boldsymbol{\beta}_9 \mathbf{RAND}_k \\ & + \boldsymbol{\gamma}_0 \mathbf{G}_{k:l} + \boldsymbol{\gamma}_1 \mathbf{M}_{i:k:l} + \boldsymbol{\gamma}_2 \mathbf{TG}_{jk:l} + \varepsilon_{ij:k:l} \end{aligned} \quad (2)$$

By using the GLMM framework, *W* can be either continuous or dichotomous and can vary at either the individual level or the group (either team or site) level. To test the significance of the moderating effect of W_{ij} on the intervention effect, one simply tests the significance of β_6. Although none of the WFHN's primary research aims involve moderator effects, some secondary research aims to examine moderation at various levels. Therefore, the WFHN's data collection was designed, at the proposal stage, to have adequate power to detect medium-sized moderator effects on key outcomes. The complicated nesting structure of the actual data and the shifting of work sites encountered in the field make the power to detect moderator effects an open question. If future analyses are unable to detect moderator effects across outcomes, then we will perform ex post power calculations to assess the potential for Type II error.

Once the shifting nature of work sites and the need for adaptive randomization became apparent, we realized that specifying the GLMM analyses was sufficiently complicated that a priori decisions on specific components, such as variance structures, were inappropriate. Thus, given the complicated and varied nature of potential WFHN analyses, all research centers agreed that no single model could be applied to all analyses. However, to address the need for consistency and rigor across all WFHN analyses, the WFHN developed a protocol that was designed to encourage the use of best analytical practices, while allowing each specific analysis to be appropriately informed by disciplinary norms and the particular research question under examination.

As the first step in the process, a cross-disciplinary Publications Committee with representation from every center commissioned writing groups to address key WFHN hypotheses and approved any secondary analyses proposed by WFHN researchers. All writing groups outlined their prospective analyses and submitted them for review and comment by the Publications Committee. Additionally, a Measures and Analysis Committee was created to provide analytical assistance and advice to all writing groups. The Measures and Analysis Committee consisted of the senior methodological experts from across the WFHN.

Given the complicated nature of WFHN analyses, the Measures and Analysis Committee agreed that all analyses should start from a common framework so that fundamental problems could be identified and resolved before more complex analytic strategies were attempted. Writing groups could then expand from this framework in the most appropriate direction for their particular analysis. The Measures and Analysis Committee developed an analysis plan template that embodied this common framework and facilitated the use of best practices across research disciplines and centers. This template also ensured that WFHN-specific analytical issues, such as the clustering of

work sites and the adaptive randomization, were handled appropriately.

The template asked that writing groups begin with a starting point of rigorously exploring the data and variables to be used. As a part of this template, each writing group was asked to start with intent to treat (ITT) analyses using the basic GLMM framework from equation 1 in which the random effects structure is based on the organizational structures present at the time of randomization. ITT analyses estimate the effect of assignment to a study condition regardless of actual treatment received and are considered the gold standard for randomized studies, so they were chosen as the best starting point for all analyses.

From this starting point, writing groups were free to explore alternative treatment effect specifications (e.g., dose effects or the effect of treatment as received) and alternative random effect specifications (e.g., dynamic site membership or random effects reflecting organizational structures at follow-up) based on the specific hypothesis being tested. As writing groups encountered specific problems or questions in their analyses, they consulted the Measures and Analysis Committee for assistance.

Challenge 4. Assessing Daily Processes of Families

A fourth challenge encountered by the WFHN was to understand how the intervention affects the daily lives of employees and their families. Of particular concern is the assessment of how work stressors cross over into family life to affect the health and well-being of employees and their children.

To learn how the work site intervention affects the daily life of employees and their children, we conducted a daily diary sub-study focused on a subsample of the intervention and comparison group employees in Company 1 (N = 182) and Company 2 (N = 131) and their children ages 9 to 17. We performed two data collection bursts, one at baseline and the other at the 12-month follow-up. Employees with children in the target age range were recruited during the work site interviews to participate, along with a child in the target age range (their child closest to age 13), in a series of eight consecutive nightly telephone interviews. To minimize the duration between initial baseline interviews and ensure daily assessment prior to the start of the intervention, respondents were given a 4-week window to initiate the interviews. During these nightly calls, parent and child were asked, in individual interviews lasting about 20 minutes for the parent and 15 minutes for the child, about their family experiences, physical and emotional well-being, and experiences of stress during the day of the call. During four of the call days, parent and child were also asked to provide saliva samples over the course of the day; parents provided five samples per day and children provided four samples per day.

The samples were assayed for diurnal cortisol, a biomarker of stress that has been implicated in the stress response of the hypothalamic-pituitary-adrenal (HPA) axis. The diurnal rhythm of salivary cortisol typically peaks shortly after waking in the morning (i.e., the cortisol awakening response) and then gradually declines throughout the rest of the day. This diurnal rhythm of cortisol provides information about individuals' chronobiology (Keenan, Licinio, & Veldhuis, 2001) and may provide the best window into stress physiology, providing information about overall levels and fluctuations in cortisol across the day and the association of these characteristics of cortisol with exposure to stressful experiences and individual/contextual factors (Almeida, McGonagle, & King, 2009; van Eck, Berkhof, Nicolson, & Sulon, 1996). The diary component provides an in-depth examination of the implications of the work site intervention for the daily stress and daily emotional and physical health of employees and their children.

In the daily diary interviews, daily stressors were assessed via the Daily Inventory of Stressful Events (DISE) (Almeida, Wethington, & Kessler, 2002). The DISE includes stem questions asking whether certain types of stressors occurred in the past 24 hours; probe questions that obtain stressor content, severity, and threat; and the respondents' appraisals of any stressors. Each day, employee parents were asked about work stressors—work arguments, tensions, stressors involving a coworker, work demands, and

an option for any other stressor at work. Employees also reported stressors outside of work—arguments, tensions, demands at home, stressors involving a close friend or relative, or any other stressor that occurred. Employees were also asked about positive events, either at work or at home, in the past 24 hours.

A parallel version of this interview was developed in Phase 1 of the WFHN for use with children. The Phase I items have good reliability within scales and demonstrated predictive validity with their associations with parents' reports of work-family conflict (Almeida & Davis, 2011). Children reported daily whether they had an argument with their (employee) parent or others, they were being asked to do more work around the house than they thought they should have to do, anything happened to a friend or relative that was stressful for them, or anything else had upset them. Children were also asked whether anything good happened with their (employee) parent or whether anything else happened that most kids would consider good or fun.

The diary interview also includes questions on time use in the past 24 hours, using questions previously used in the National Study of Daily Experiences (Almeida & McDonald, 2005). Questions include time for leisure, taking care of children, household tasks, and giving and receiving support. Children reported on time spent in various activities with each parent, including doing chores, school activities, and hanging out or talking. Parents and youth also reported on time adequacy, using an adapted version from the interviews (Van Horn et al., 2001). Daily work and family productivity were assessed using items adapted from the National Study of Daily Experiences (Kessler, Almeida, Berglund, & Stang, 2001). Parents indicated how much they cut back on normal paid (work) activities on a given day and how much the quality of work suffered. They answered parallel questions about family activities.

We measured daily psychological well-being using an adapted inventory of the Positive and Negative Affect Schedule (Watson et al., 1988). Children also reported on parents' moods after work. We assessed daily physical health using an adapted version of a symptom checklist (Almeida, 1998; Charles & Almeida, 2006; Larsen & Kasimatis, 1991). This scale was validated in the National Study of Daily Experiences (Almeida et al., 2002; Charles & Almeida, 2006). We measured health behaviors in terms of participants' reports of the number of alcoholic and caffeinated drinks consumed and, adapting items from the Fagerström Test of Nicotine Dependence, tobacco use and dependence (Heatherton, Kozlowski, Frecker, & Faegerstrom, 1991). In addition, each day parents rated their level of cognitive interference such as unwanted and potentially ruminative thoughts (Stawski, Sliminski, & Smyth, 2006) and memory failure (e.g., forgetting a meeting) according to a scale developed by Mogle (2011).

Each day, the parent and child assessed daily parent-child interactions using items adapted from the Parent-Child Affective Quality questionnaire (Spoth et al., 1998). Children answered questions about whether they had contact with their parent at work and, if so, how they contacted their parent. Parents and children both reported on how much the employee parent knew about the child's daily activities (Stattin & Kerr, 2000). Parents also reported on their child's care arrangements after school each day and the extent to which they were worried about their children while they were at work, using an adaptation of the Barnett and Gareis (2006) parental after-school stress measure.

Specifically related to the intervention targets, employees were asked daily about the scheduling of their work shifts (start, end, location) and how supportive their supervisor was in general and about work and family issues specifically. On the final day, Day 8, employees also rated their supervisors' family and personal life supportive behaviors, using items from the work site interview (Hammer et al., 2009).

Challenge 5. Implementing a Participatory Initiative

The final challenge was to implement a participatory initiative that created new work practices and processes to increase employees' control over work time while still meeting business needs. This initiative needed to be implemented as an experimental intervention that targeted the relevant aspects of the

psychosocial work environment identified by theory and our previous studies. To meet this challenge, the WFHN conducted a rigorous process evaluation and engaged in translational activities to ensure that the results of the WFHS provide utility to employers, employees, and families.

The WFHN Process Evaluation

Scholars and occupational health advocates have lauded workplace interventions that aim to change the organization of work, rather than, or in addition to, stress management or health promotion programs that target employees as individuals. However, the evidence for these organization-level interventions is mixed (van der Klink, Blonk, Schene, & van Dijk, 2001), and process evaluations are needed to assess whether null or negative effects are due to inadequate programs—interventions that do not prompt changes in the selected outcomes even when delivered as planned—or inadequate implementation of the planned interventions (Nielsen, Randall, & Christensen, 2010; Semmer, 2006).

A detailed process evaluation is especially important for this study because the intervention encourages employees and managers to individually and collectively enact new ways of working that increase employees' control over their work time and demonstrate greater support for personal and family life. The intervention is both highly scripted and very participatory and interactive. Structured messages are presented to all, but participants in different work sites may choose to focus on different changes to implement. Although this participatory style is congruent with community-based health promotion within a workplace setting, it requires detailed data on how the change process unfolds in different sites and an integrated analysis of intervention implementation and effectiveness (Nielsen, Fredslund, Christensen, & Albertsen, 2006; Nielsen et al., 2010).

The process study was organized around five concepts: context, exposure, fidelity, implementation, and participant assessment. In both companies, field staff used semistructured interviews with management and informal observations to document the work site context, focusing on confounding events (e.g., restructuring, new regulations or policies introduced during the study period) that seem likely to affect employees' experiences and/or complicate our analysis of intervention effects (Olsen et al., 2008). The process evaluation included qualitative contextual data from both intervention and comparison sites, unlike many community-based studies (Steckler & Linnan, 2002). Intervention facilitators and field staff collected detailed data on employee and manager exposure to, and participation in, all intervention activities.

Exposure is measured at the individual level but also aggregated to the work site level to investigate whether a higher dose of the intervention within the work site creates more change for individuals in that site. Exposure measures can be used in dose-response and treatment-as-received analyses, although the WFHN is prioritizing ITT analyses as described above.

The fidelity of the intervention was monitored to track whether the key messages and activities of the intervention were presented as planned and to document why variation occurred, if it did. The process evaluation also assessed the implementation of the intervention outside of formal activities, with observations and qualitative interviews asking about new practices, processes, or policies that were attempted and sustained in different work sites. Finally, as part of the translational research goals, the process study gathered data on managers' and employees' assessment of the intervention during and after the intervention period (see also Kelly et al., 2010).

Table 6 describes the data sources and products for the process evaluation. We prepared site reports to share with the WFHN, and we quantified exposure and fidelity data and appended them to the employee survey data as site-level variables for use in multilevel analyses.

Table 6. WFHN process data sources and products

Goal	Data Sources	Products
Organizational context	Meetings with internal study sponsors and company advisory boards; observations; administrative data	Organizational profile; some measures appended to survey (e.g., date of organization-wide policy changes)
Work site context	Interviews with managers; observations; administrative data	Site profile; some measures appended to employee survey (e.g., change in management, restructuring occurring during study period)
Exposure	Documented completion of computer-based training and behavioral self-monitoring	Individual-level and work site–level rates appended to survey data
Exposure	Attendance sheets for each session	Individual-level and work site–level attendance rates appended to survey data
Fidelity of intervention activities	Tracking sheets for sessions (e.g., topics covered, questions raised, deviations from planned activity) completed by facilitators and field staff	Aggregate fidelity measures for work sites appended to employee survey; summary of fidelity issues across sites
Fidelity of intervention activities	Observations of selected sessions at each site	Coded field notes
Implementation of intervention	Reports of early experimentation with changes in last sessions and informal conversations; formal feedback interviews several months after intervention activities	Coded field notes and interview transcripts; summary of changes implemented across sites
Participants' assessment of the intervention	Observations of sessions and informal conversations during intervention period; formal feedback interviews and the innovation attribute questionnaire	Coded field notes; coded interview transcripts; short questionnaire assessing trialability, usability, etc.

WFHN Translational Activities

Effective workplace interventions to reduce work-family conflict are useful only if, subsequent to effectiveness testing, they are then communicated to and adopted by workplaces, put into practice, and sustained. Achieving this dissemination and implementation objective is a basis for much foment among researchers in public health and health care (Brownson, Colditz, & Proctor, 2012). Adoption, trial, implementation, and sustainability rely on overcoming individual, team, site, organization, and company barriers to the translation of research findings into practice.

One evidence-based approach to reduce barriers to change is to anticipate them through formative evaluation research and through asking strategic questions about translation prior to the launch of an evidence-based intervention (Glasgow & Emmons, 2007). A key to this approach is to pair marketing research with diffusion research so that novel baseline data about industry sectors, advice-seeking relationships among potential adopters within sectors, and psychological and sociological triggers for eliciting market demand can be gathered and used in purposive efforts (Dearing, Maibach, & Buller, 2006).

We pursued translation through two complementary activities. One was short-term and practical—to use feedback from WFHS participants to inform post-study messages and roll-out. These translational activities were embedded in the WFHS design and drew on reanalysis of process study data of employee and manager reactions to the intervention, and suggestions from WFHN's advisory board, which consists of corporate human resource leaders and labor leaders.

A second translational activity is longer-term and research-directed and consists of two design-stage translational research efforts. The first of these efforts recodes and analyzes existing process data to learn how employees and managers perceived the WFHS intervention so that evidence-based portrayals of the intervention can be developed and evaluated as effective communication tools. The objectives of the

first design-stage effort are to understand work-life needs, the perceived salience of work-life issues in large organizations, and perceptions of representative and elite respondents about prototypes of a WFHN intervention.

To achieve these objectives, we described the WFHN intervention to the WFHN advisory board to explore board members' perceptions of company and organizational barriers and facilitators and the salience of these issues. We asked closed-ended questions about board members' perceptions of the intervention's cost, compatibility, effectiveness, simplicity, and observability. We also asked similar questions of stratified small samples drawn from members of the professional association WorldatWork who are more representative of most potential adopters of the WFHN intervention. We used these qualitative and quantitative data to craft communication materials about the intervention. In conjunction with members of the professional association, we will eventually disseminate these materials to key informal opinion leaders and then to the full set of potential adopters.

The second design-stage translational research effort critically assessed ways to inform the information technology industry and the extended care industry about the WFHS intervention to encourage them to adopt the intervention. The objective was to identify a priority audience of potential adopters of a WFHN intervention, gather data about their advice-seeking behaviors, and identify key informal opinion leaders among them so that we know who to contact about the WFHN intervention when its results are ready to be communicated. Because human resource leaders in large organizations are likely to make or be involved in decisions about work-life interventions of this scope, we have partnered with WorldatWork to administer a survey to work-life professionals among their membership.

In addition, we conducted a purposive snowball sample among stakeholders in each industry to identify informal opinion leaders. Snowball sample data are qualitative and were used as a complementary method for identifying informal opinion leaders. Respondents to both protocols indicated who they go to for advice when considering the adoption of work-life innovations. We analyzed the resulting data using the social network analysis program InFlow (OrgNet.com, Cleveland, OH) to understand the overall WFHN structure, the composition of groups within the WFHN, and the advice-seeking and advice-giving behavior of individual human resource professionals. We calculated measures of actor centrality, especially betweenness—defined as the extent to which an actor serves as a connection through which other actors can contact each other—to identify and rank-order informal opinion leaders who disproportionately influence the diffusion (and non-diffusion) of innovations within this network of human resource professionals.

These formative research data collection efforts will be used as inputs to a diffusion intervention to examine the efficiency with which the intervention diffuses to other organizations. Together, the data about perceptions of the intervention and about dissemination channels will be used to stimulate market demand for this intervention and its principles. The scientific literature on diffusion of innovations and social marketing (Dearing & Kreuter, 2010) indicates that the likelihood of adoption is increased by the existence of consumer pull (i.e., consumers requesting the intervention) in addition to the more typical academic and federal agency reliance on source push (i.e., intervention developers promoting the intervention).

Conclusion

Although the prevalence of family-friendly or work-life policies in US workplaces has increased dramatically in recent decades, few longitudinal studies have used experimental designs to evaluate the effects of specific work-family interventions on work, work-family conflict, and health outcomes. More broadly, sociological and epidemiological theorizing of the effects of social environments on health has advanced, but there have been few empirical studies of changes in those social structures and how shifts in the social structures affect individuals (for a review of this literature, see Kelly, Ammons, Chermack, & Moen, 2008). While studies of fixed social structures (gender, education,

race/ethnicity) have been essential in spotlighting the production and reproduction of inequalities, including health disparities, social structures do sometimes change and can be altered deliberately with psychosocial interventions. Work-family policies that attempt to change the rules, expectations, and practices of workplaces regarding how employees' lives off the job are recognized and supported are one such shift in the social structure of the workplace.

To address this critical gap in the knowledge base supporting work-family policies, the WFHS design uses multiple methods to yield evidence at multiple levels (Subramanian, Jones, & Duncan, 2003), including the organization, work group/site, employee, and family. An employee and family-level effectiveness study is used to assess the effect that the intervention has on employees and their families. To yield a more in-depth understanding of how work-family conflict and the WFHN intervention impacts family functioning, the design also includes a daily diary study that drills down into the daily processes of families. Similarly, an in-depth process study seeks to understand the workplace context in which the intervention is implemented and the impact that the intervention has on the work site and the broader organization. Finally, a late-stage translational study will yield information about how best to position the results to attract the attention of decision makers in the broader business community whose organizations are logical potential adopters of the intervention.

This paper presents a high-level synopsis of the design and methods used by the WFHN, framed within the context of challenges faced by the multidisciplinary team in designing this ambitious study. Across all challenges, a common theme has been the need for flexibility and adaptability of the study design and methods to the practical constraints imposed by conducting large-scale field experiments. Throughout, we have used randomized, pragmatic trial design principals as guidelines to maintain the scientific integrity of the study.

These principals emphasize the need to establish and adhere to specific design and methods parameters a priori, but strict adherence to a priori decisions is often impossible with field research. Thus, we have adopted the principal of transparency in our changes. This paper presents the major design changes and our approach to maintaining consistency to a priori design principals rather than to specific design elements and methods. We contend that this transparency, rather than adherence to a priori decisions, is the cornerstone of scientific integrity.

At completion, the WFHS results will provide rigorous evidence on the ability of workplace interventions to reduce work-family conflict and improve the health and well-being of supervisors, employees, and their families. In addition, the WFHS results will yield critical new evidence on the effect of workplace interventions on the climate and performance of work teams and on broader organizational outcomes, such as productivity, turnover, and workplace costs.

When paired with the WFHN's translational activities, the WFHS findings will support the broad dissemination and resulting diffusion of effective work-family policies and interventions, thereby improving the lives of millions of American workers and their families.

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Acknowledgments

This research was conducted as part of the Work, Family & Health Network (www.WorkFamilyHealthNetwork.org), which is funded by a cooperative agreement through the National Institutes of Health and the Centers for Disease Control and Prevention: *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (Grants # U01HD051217, U01HD051218, U01HD051256, U01HD051276), National Institute on Aging (Grant # U01AG027669), Office of Behavioral and Social Sciences Research, and National Institute for Occupational Safety and Health (Grants # U01OH008788, U01HD059773). Grants from the National Heart, Lung, and Blood Institute (Grant #R01HL107240), William T. Grant Foundation, Alfred P. Sloan Foundation, and the US Department of Health and Human Services Administration for Children and Families have provided additional funding. The contents of this publication are solely the responsibility of the authors and do not necessarily represent the official views of these institutes and offices. Special acknowledgement goes to Extramural Staff Science Collaborator Rosalind Berkowitz King, PhD, and Lynne Casper, PhD, for design of the original Workplace, Family, Health and Well-Being Network Initiative. For a complete list of all WFHN collaborators, please visit http://www.kpchr.org/wfhn.

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