

Final Progress Report

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Abstract:

Work organization and the psychosocial stresses of the workplace have received increasing attention in the past decade as potential contributors to ill-health. With the increase in participation in more physically demanding and socially challenging work roles has come a new interest in the effect of these stressors on reproduction, particularly on adverse pregnancy outcomes. Evidence suggests that some groups of pregnant workers may be at risk for premature delivery or small-for-gestational-age (SGA) births as a consequence of workplace stressors. Clear associations between occupational stressors and adverse pregnancy outcomes have been, to date, difficult to draw. Factors including study design, retrospective assessment of exposure, and choice of exposure measurement may be partially obscuring any association between work-related stress and pregnancy outcomes. The work here represents an important intersection of three important areas where significant gaps in knowledge exist, and where further understanding of exposures is important for the design of subsequent studies.

The overall goals of this developmental and planning grant were to obtain preliminary data assessing two models of occupational stress during pregnancy, in particular measuring repeatedly and longitudinally across the course of pregnancy to evaluate the possibility that work stress may change across pregnancy. This proposal aims also to evaluate the use of the effort-reward imbalance (ERI) model, which has not been tested in pregnant workers or used in studies of pregnancy outcomes. As sufficient data do not exist on the measurement and range of these exposures during pregnancy, or in the US population of this age and gender, it is essential that the elements used in exposure assessment be carefully measured, both to obtain baseline values in early pregnancy, and to assess the degree to which these values may vary across the course of pregnancy. It was intended to inform subsequent studies to test (with sufficient power) the possibility that psychosocial stressors in the workplace exert an effect on pregnancy. The work here represents a necessary first step in the ability to test these hypothesized effects, and will assist in determining whether newer models of the psychosocial parameters of stress in the workplace might be useful in measuring an association with adverse pregnancy outcomes. As well, this work represents an initial assessment of whether changes in measured parameters of stress, or distinct trajectories over time, occur during the course of pregnancy.

Principal aims of the study were:

- 1) To explore the use of newer instruments measuring occupational psychosocial stressors in pregnant women; specifically using the Effort-Reward Imbalance (ERI) model, with comparison to, and possible combination of features with, the Demand-Control (DC) model.
- 2) To evaluate the psychometric properties of the ERI in pregnancy, including reliability, and content validity.
- 3) To evaluate the construct validity of the stress scales, to enable their use in measuring occupational psychosocial strain in pregnancy.
- 4) To evaluate the possibility that occupational psychosocial stressor levels in working women change across the unique time period represented by pregnancy, assessing the direction and magnitude of this change.

In summary several important findings were noted that reflect on the design of future relevant studies. The psychometric properties of the Effort-Reward Imbalance model were exceptionally good, with Cronbach's alpha uniformly greater than 0.7 for all scales of the model; this contrasted with the scores for job control, which were under 0.4. This may reflect,

as in our earlier work, the fact that the ERI model is of greater measurement validity in a service economy, contrasted with the Demand -Control model and its origins in an economy more weighted to manufacturing. Subject scores on the ERI model showed a decline across time during pregnancy, with a concomitant increase in job control (non-significant) and no change in effort-reward imbalance across pregnancy.

The possibility of a critical period through which occupational psychosocial stressors act is given credence by these results. We find that correlations between intermediate outcome variables related to pregnancy outcomes (blood pressure, self-rated fatigue), and occupational psychosocial stressors are greatest and statistically significant (ranging from 0.35 to 0.59, $p < 0.01$) at the second measurement wave, corresponding to mid-pregnancy and the timing of early fetal growth. In longitudinal models, intermediate outcome variables (self-rated fatigue) were significantly related to work overcommitment. We find much weaker correlations with occupational psychosocial variables and actual birth outcomes, especially birth weight, although this is not surprising since the study was not designed with sufficient size and power to specifically test this hypothesis. These results are in accord with a modest effect of overcommitment on the health of women subjects, and do point to the possibility that work characteristics may affect intermediate health endpoints that have modest consequences on fetal growth and development.

Substantial differences in occupational characteristics between blacks and white/Hispanic subjects were found, consistent with the PI's prior work and which show lower values in blacks once adjusted for age and education. That these values are similar to whites, or higher, in Hispanics (and are persistently higher, or improve with adjustment for education) suggests differential access to higher-quality or less stressful work despite equivalent levels of education, and is likely in part explanatory of the findings of several past studies noting higher risk for adverse birth outcomes in college-educated black mothers versus both college-educated whites and blacks without a college degree. This may inform the design of future studies which should encompass measurement of factors such as economic barriers and discrimination that would provide potential explanatory data for both findings related to occupational trajectories and outcomes related to long-term differentials in health consequent to work factors.

In summary, these findings from the R-21 Preliminary/Planning grant may be of substantial value in the planning of more formal targeted and larger scale studies that can be designed to measure the effect of working conditions and occupational psychosocial stressors on birth and perinatal outcomes.

Highlights/Significant findings:

Overall the three scales based on the Effort-Reward Imbalance model had excellent psychometric properties, with alpha values for each construct as follows: Reward 0.725; Effort (without physical exertion) 0.720; and Overcommitment 0.823. Inclusion of physical exertion scales in the Effort construct reduced the alpha value to 0.651, suggesting that physical effort represents a different factor or construct than the other psychosocial measures inherent in the questions.

Measures of occupational characteristics and stressors were reasonably uniform throughout all four waves of the study, with mild but progressive declines in work effort, work rewards, and work overcommitment. Effort-reward imbalance, the degree to which effort matches or exceeds perceived rewards remained essentially unchanged across pregnancy, as both effort and reward fell together. It should be noted that this value is high, as a value of 1.0 indicates that work effort is balanced by rewards, and suggests that job rewards are uniformly less than the perception of effort entailed in working.

Measures of stress and fatigue tended to be mildly elevated early in pregnancy, reduced in mid-pregnancy, and then increased again near term. Blood pressure readings exhibited similar findings, with an increase toward term, though with very little variation from baseline values.

Bivariate correlations of longitudinal stressor measurements with intermediate outcomes measures (self-assessed fatigue, stress, and blood pressure measurements) showed moderate and statistically significant correlations with Effort-Reward constructs, in particular for overcommitment, less so for effort-reward imbalance. For overcommitment, correlations were 0.38 with fatigue, 0.59 for self-rated stress, and 0.35 for systolic blood pressure.

Mean salivary cortisol levels showed a small but statistically significant rise across the course of pregnancy (0.41 ug/dL at Wave 2 versus 0.54 at Wave 4; $p < 0.01$ for paired t-test comparison). Salivary cortisol was only weakly correlated with occupational characteristics/stressors and with birth weight, suggesting weak associations for this particular biomarker.

Bivariate correlations of occupational characteristics showed the strongest correlations with low birth weight when measured at Wave 2, or approximately mid-second trimester (20-24 weeks); this is a period that is slightly early, but otherwise consistent with, the concept of a critical period for the association with stressors (both work and non-occupational) with adverse birth outcomes, including low birth weight and preterm delivery.

Differentials in self-assessed occupational stressors varied by race/ethnicity. Lower self-rated job characteristics were noted in black subjects when contrasted with white and Hispanic subjects, even though levels of educational attainment were equivalent in black and white subjects. Trajectories of occupational characteristics also exhibited a decline in black subjects across the course of the pregnancy, whereas they were stable in whites/Hispanics. Further exploration of racial/ethnic differences in work characteristics discloses additional findings potentially relevant to explanation of the above findings. For all work characteristic variables except overcommitment, black subjects were noted to have lower (i.e., worse) self-rated values than whites, while Hispanics approximated or exceeded those in whites. These data suggest (in common with studies of other datasets by our group) that equivalently "better" (i.e., more rewarding or autonomous) jobs are not being obtained by black subjects, contrasted with white/Hispanics, despite equivalent or better levels of educational attainment.

Trends and trajectories in subjects' score for overcommitment were modified by the presence or absence of specific time for maternity leave provided by the workplace. The results suggest that initial scores on overcommitment are higher in subjects having a workplace maternity leave benefit, but that scores significantly decreased with time, indicating a potential positive benefit of the policy on one of the more substantial work stress scales.

Translation of findings:

These findings from the R-21 Preliminary/Planning grant may be of substantial value in the planning of more formal targeted and larger scale studies that can be designed to measure the effect of working conditions and occupational psychosocial stressors on birth and perinatal outcomes. At present, because of the preliminary nature of the work, and the tentative nature of the hypotheses advances, the findings do not yet have direct applicability to workplace interventions, without larger-scale testing. However, three useful points emerge from this work that will assist in informing subsequent studies:

- a) excellent psychometric properties of the newer ERI scales, which provided evidence of their validity in subsequent studies
- b) evidence for a critical period in mid-pregnancy, through which occupational stressors may exert their effects, and which may improve the ability of studies to examine associations between these stressors and adverse birth outcomes
- c) evidence for disparities between black and white/Hispanic subjects in self-rated job characteristics and stressors, despite equivalent educational attainment, which suggests the need for further research into mechanisms by which translation of education into appropriate work is differentially blocked along racial/ethnic lines

Scientific report:

Methods: Subjects were administered the initial study questionnaire at a time close to the initiation of prenatal care, at approximately 8-12 weeks gestation. The questionnaire was principally designed to gather initial data to assess both the Effort-Reward Imbalance and Demand-Control models in early pregnancy. Effort-Reward Imbalance (ERI) questions were those developed, and piloted by Siegrist and colleagues in the mid-1990s. The ERI instrument includes questions on three major scales: the extrinsic factors of effort (6 questions, including one on physical load) and reward (three subscales: esteem, 5 questions; job promotion, 4 questions; job security 2 questions), and the intrinsic factor, overcommitment (6 questions). Scoring on a unidimensional scale was performed, using an additive score from 6 to 24 with the higher scores representing overcommitment. Task-level work characteristics for the assessment of the Demand-Control model in pregnancy will be measured using a shortened version of the Karasek demand/control instrument. Workplace demands were considered equivalent to the Effort scale of the ERI questionnaire. Nine questions were used to assess the dimension of control, including control over the pace and content of work, decision authority/latitude, and skill discretion. Measurement was on a four-point scale from strong agreement to strong disagreement with the questions presented as statements about the subject's job. Physical demands of the job were assessed through six questions taken from the European multicentre study on women's work and preterm birth; these include assessment of standing, strenuous postures and positioning, and weight/load lifting and carrying. Several questions were developed for subjects to indicate whether they had modified, or were able to modify their work because of the pregnancy; these included questions on both modifications of physical demands (change in time spent standing/lifting/carrying, or weight lifted/carried) and whether working hours were modified or shortened). Home roles, including physical activity, social support, and psychosocial demands were assessed through use of a shortened version of the Psychological Housework Demands Scale (PHDS) which has been previously used and validated in this center for individuals with chronic disease and measures time constraints, benefits and difficulty of family work. Family-Work Conflict was assessed using the measures developed by Frone and colleagues to measure both Work to Family and Family to Work conflict. The scale consists of four items that assess the degree to which participants' jobs interfere with home life and the degree to which home life interferes with job performance.

Demographic and obstetric information (age, ethnicity/race, gravidity/parity, educational level, smoking, alcohol), health status (presence of chronic or ongoing disease) and socioeconomic variables associated with maternal health and preterm delivery, including partner employment, income (both individual and total household) and health insurance were also ascertained.

Brief self-reported measures of perceived stress, fatigue, and general health were obtained as single-item measures. A single-item measure of stress symptoms, which provided a definition of stress and recorded, on a four-point scale, the degree to which subjects agreed that it represented their current experience, was used as well as single measures of self-reported health status, following similar reporting methods. Blood pressure readings were taken on the first visit and recorded. Salivary cortisol measurements as indices of plasma free cortisol were sampled twice to evaluate resting basal morning peak cortisol levels at the start of the study and again at 28-31 weeks, a period at which increased association with maternal stress has been noted in prior studies. Lastly, information on pregnancy outcome, including date of delivery (from which gestational age can be calculated) and birth weight were obtained from the post-partum subject.

Following the initial interviews, questionnaire administration was repeated via similar interviews. Pregnant subjects were interviewed three additional times during the pregnancy: once each at mid-to-late second trimester (20-24 weeks), early third trimester (28-31 weeks), and later third trimester (35-38 weeks). Interviews repeated questions from the ERI and DC models outlined above, re-assess physical demands and home demands, and any job modifications since the previous questionnaire. The single-item measures of self-reported stress, fatigue and health, as outlined above in the initial interview, will be repeated, and blood pressure measurements (obtained in office visits) recorded. Any complications of pregnancy will be noted. Information on the timing and duration of gestation was reviewed in the event that gestational dates established earlier have been modified in the intervening time. If a subject left work in the interval since the last interview, the date of last work was noted, and the reason for leaving ascertained and recorded. Interviews with subject who left work continued to obtain data on home demands, and self-reported stress and health. Subjects were recontacted shortly after the expected date of delivery and birth date and weight ascertained. Data from the questionnaires was recorded on Teleform forms, which were optically scanned, inspected and cleaned, and transferred into an SPSS database for analysis

Subjects: Characteristics and demographics: A total of 61 individuals completed the first interview, at or before 12 weeks gestation. Although the numbers were smaller than planned, attrition in the subjects was less than expected: 57 subjects (93%) completed two waves; 55 (90%) completed three, and a total of 49 subjects (80.3%) completed all four interview waves. Reasons for non-completion of all four interview waves were miscarriage/non-viable delivery (6 subjects; 9.8%), preterm delivery (4; 6.6%) and loss to follow-up at last interview (2; 3.3%). The extensive data collection involved meant that all data collection forms were not scanned and entered into a complete database until Sept 25, 2008; therefore the more complex analyses proposed for this project are still ongoing and being undertaken.

Mean maternal age was 30.9 years, close to the mean age in working mothers of 30.0 (based on the 2000 CT Birth registry); ten subjects (16%) were aged 35 or older. Self-identified ethnicity of the subjects was very close to that of the overall composition of the Connecticut birth population as a whole: 46 (75%) were non-Hispanic White, 8 (13.1%) Black and 7 (11.5%) Hispanic. The group overall was somewhat more educated, with median education at 16 years or a college (bachelor's) degree. 80.3% lived with a spouse; another 11.5% lived with the father, while only 5% were living as a single. Median personal income was between \$50,000 and \$99,000, as was median family (all-source) income.

Principal aims were as follows, and are dealt with together in the following narrative:

- 1) To explore the use of newer instruments measuring occupational psychosocial stressors in pregnant women; specifically using the Effort-Reward Imbalance (ERI) model, with comparison to, and possible combination of features with, the Demand-Control (DC) model.**
- 2) To evaluate the psychometric properties of the ERI in pregnancy, including reliability, and content validity.**
- 3) To evaluate the construct validity of the stress scales, to enable their use in measuring occupational psychosocial strain in pregnancy.**
- 4) To evaluate the possibility that occupational psychosocial stressor levels in working women change across the unique time period represented by pregnancy, assessing the direction and magnitude of this change.**

Scale reliability of the instruments was tested with Crohnbach's alpha. Overall the three scales based on the Effort-Reward Imbalance model had excellent psychometric properties, with alpha

values for each construct as follows: Reward 0.725; Effort (without physical exertion) 0.720; and Overcommitment 0.823. Inclusion of physical exertion scales in the Effort construct reduced the alpha value to 0.651, suggesting that physical effort represents a different factor or

Table 1. Mean (SD) values for self-rated work characteristics measured across pregnancy

Interview Wave	Control		Effort		Reward		Overcommitment		Effort/Reward Imbalance	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	12.1	2.0	14.7	4.4	20.7	7.7	13.0	6.0	1.7	0.6
2	12.0	2.0	13.7	4.1	18.5	6.8	12.4	5.8	1.8	0.6
3	12.5	2.4	13.3	4.0	18.9	7.0	11.8	5.7	1.7	0.7
4	12.5	2.4	12.9**	5.0	18.0*	6.3	11.3**	5.9	1.7	0.7

Comparison with Time 1 by paired t-test
 * p<0.1 by paired t-test
 ** p<0.01

construct than the other psychosocial measures inherent in the questions. By contrast, the one construct from the Demand-Control model assessed was job control, which had a very weak alpha value of 0.392. Reliability values for work stressor scales were not substantially changed when examined in successive waves of interviews.

Measures of occupational characteristics and stressors were reasonably uniform throughout all four waves of the study, with mild but progressive declines in several parameters. Results are shown in **Table 1**. These show progressive declines in work effort, work rewards, and work overcommitment; for each of these parameters, scores declined by 0.3 to 0.4 of a standard deviation, which was what was expected in the original proposal. Changes in job scores from wave 1 to 4 were significant for effort and overcommitment and approached significance for reward. Job control showed a small, non-significant increase, while effort-reward imbalance, the degree to which effort matches or exceeds perceived rewards remained essentially unchanged across pregnancy, as both effort and reward fell together. It should be noted that this value is high, as a value of 1.0 indicates that work effort is balanced by rewards, and suggests that job rewards are uniformly less than the perception of effort entailed in working.

Outcome variables:

Measures of stress and fatigue tended to be mildly elevated early in pregnancy, reduced in mid-pregnancy, and then increased again near term. Blood pressure readings exhibited similar findings, with an increase toward term, though with very little variation from baseline values. For self-assessment of fatigue, the single-item question on perceived stress, and blood pressure, results were as follows:

Table 2. Mean (SD) values for outcome variables measured across pregnancy

Interview Wave	Fatigue		Stress		BP sys		BP diast	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	68.7	23.1	2.9	1.0	114.7	9.8	69.8	9.3
2	50.1	26.1	2.6	1.2	114.2	11.2	68.2	8.3
3	59.3	21.9	2.8	1.0	115.9	12.4	69.4	8.5
4	68.8	21.3	2.8	1.0	118.4	10.9	73.5	7.5

Table 3. Birth weight outcomes for subjects by demographic criteria	
Variable	Mean BW (grams)
Mothers Age-Group	
<35	3384
>=35	3514
Education	
High School Diploma or GED	3383
Less than 2 years college	3642
Associate degree or more than 2 years college	3238
Bachelor's degree or equivalent 4 year degree	3408
Post-Bachelor's study or Master's degree	3447
Doctoral or Professional degree (PhD, MD, JD, etc)	3111
Own Personal Yearly Income	
\$20,000 to \$29,000	3143
\$30,000 to \$39,000	3241
\$40,000 to \$49,000	3270
\$50,000 to \$99,000	3511
\$100,000 or more	3671
Ethnic Group	
White	3412
African-American or Black	3150
Hispanic or Latin American	3620

Mean birth weight in the subjects was 3405 grams, slightly higher than the year 2000 mean for working women in Connecticut (3393g). Birth weight (BW) showed expected trends, increasing with personal income and age, and demonstrating an inconstant relationship to education, reducing with the highest level of education. Mean birth weight was higher for Hispanic mothers and reduced for African-Americans, also consistent with overall Connecticut data.

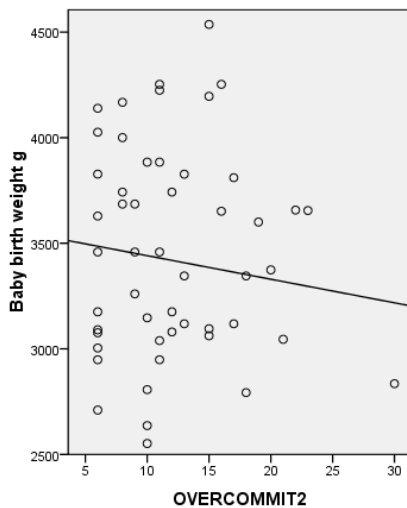
Bivariate correlations of longitudinal stressor measurements with intermediate outcomes

Table 4. Values for correlation of overcommitment scores with outcome variables measured across pregnancy			
Interview Wave	Fatigue	Stress	BP sys
1	.091	.423**	.297*
2	.381**	.588**	.347**
3	.375**	.481**	.199
4	.123	.671**	.341*
*correlation significant at p<0.05 **correlation significant at p<0.01			

measures (self-assessed fatigue, stress, and blood pressure measurements) showed moderate and statistically significant correlations with Effort-Reward constructs, in particular for overcommitment, less so for effort-reward imbalance. For overcommitment, correlations with intermediate outcome measures are shown in Table 4.

Mean salivary cortisol levels showed a small but statistically significant rise across the course of pregnancy (0.41 ug/dL at Wave 2 versus 0.54 at Wave 4; $p < 0.01$ for paired t-test comparison). Salivary cortisol was only weakly correlated with occupational characteristics/stressors and with birth weight, suggesting weak associations for this particular biomarker.

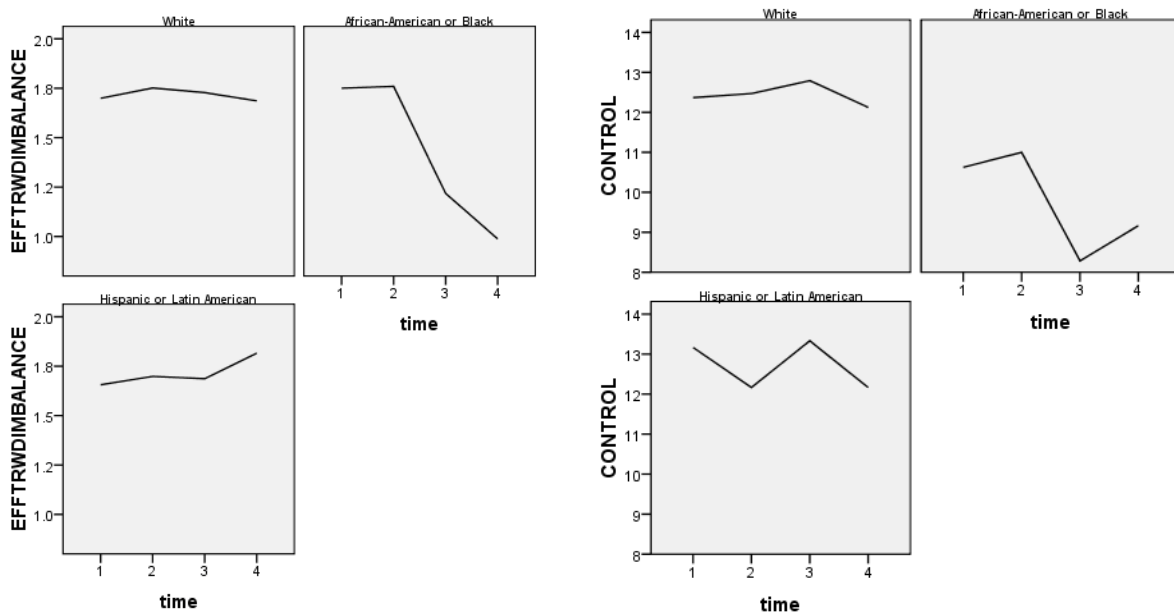
Bivariate correlations of occupational characteristics showed the strongest correlations with low birth weight when measured at Wave 2, or approximately mid-second trimester (20-24 weeks); this is a period that is slightly early, but otherwise consistent with, the concept of a critical period for the association with stressors (both work and non-occupational) with adverse birth outcomes, including low birth weight and preterm delivery. That several of the highest correlations of occupational stressor measures with intermediate health measures, particularly self-rated fatigue and blood pressure, were also noted at this period lends support to the presumptive hypothesis of a critical period occurring at some point in the second trimester or mid-pregnancy, at which effects of stressors might be manifested. The lower correlation coefficients for occupational stressors and birthweight (0.17 - 0.19 for overcommitment and effort-reward imbalance) suggests that these are either only partially and less predictive of birthweight as an outcome, and that likely they do not present a direct influence on birthweight outcomes, but instead contribute to intermediate outcomes that present potential pathways to an adverse pregnancy outcome. It should also be noted that the original proposal was not



designed to have adequate statistical power to determine the effects of the occupational variables/constructs on birthweight (but instead estimated statistical power for the intermediate outcomes listed above) since such an outcome would have entailed recruitment of too many subjects to be practicable under the R21 grant mechanism. Nonetheless these results are at least suggestive, occurring at the predicted time during gestation and in the predicted direction, even in light of the reduced statistical power available, and will form the basis for the design of further studies that can be targeted more specifically at the effect of work characteristics on birthweight. Figure 1 shows graphically the correlation between overcommitment at the second wave interview and birth weight.

A particularly noteworthy feature was the findings of differentials in self-assessed occupational stressors that varied by race/ethnicity. In accord with the PI's findings in previous datasets, lower self-rated job characteristics were noted in black subjects when contrasted with white and Hispanic subjects, even though levels of educational attainment were equivalent in black and white subjects. Trajectories of occupational characteristics also exhibited a decline in black subjects across the course of the pregnancy, whereas they were stable in whites/Hispanics. This is illustrated for job control in the adjacent figure (right side of panel), in which job control for black subjects show both a diminished baseline and drop without return in the second half of the pregnancy. A contrary finding was found however for effort-reward imbalance (left panel) in which this factor declined considerably in black subjects while remaining constant in

whites/Hispanics. This appears to be a consequence of decreased perceived effort in black subjects, as work rewards remained stable and lower in blacks than in the other two ethnicities.



Further exploration of racial/ethnic differences in work characteristics discloses additional findings potentially relevant to explanation of the above findings. For all work characteristic variables except overcommitment, black subjects were noted to have lower (ie worse) self-rated values than whites, while Hispanics approximated or

Table 5: Education-adjusted regression coefficients for job characteristics by race/ethnicity and age. Initial interview

	Control		Reward	
	Coefficient	p	Coefficient	p
(Constant)	14.8	.000	36.5	.000
Black	-1.6	.035	-4.0	.186
Hispanic	.8	.293	2.3	.460
AGE maternal	-.09	.210	-.45	.119

exceeded those in whites, although the differences between these latter two were generally not statistically significant. Table 5 shows regression modeling of scores for two of these (job control and job rewards) with coefficients adjusted for educational attainment, using white subjects as the referent group (constant). These data suggest (in common with studies of other datasets by our group) that equivalently “better” (ie more rewarding or autonomous) jobs are not being obtained by black subjects, contrasted with white/Hispanics, despite equivalent or better levels of educational attainment.

Testing of occupational stress trajectories has been of necessity limited by the fact that the full dataset has not yet been available until recently. Therefore some initial results are shown, which are based on the first 48 subjects to have completed the pregnancy and had their data scanned and entered. Trajectories of work characteristics/stressors were examined with respect to their modification by fixed or level-2 characteristics of work. In this case, trajectories in subjects’ score for overcommitment were modified by the presence or absence of specific

time for maternity leave provided by the workplace, as shown in Table 6. In this case, the results suggest that initial scores on overcommitment are higher in subjects having a

Table 6. Multilevel regression of trajectories of overcommitment across time: effect of maternal leave as a level-2 modifying variable

Fixed Effect	Standard Coefficient	P-value
INTRCPT2, B00	7.65	0.016
MLEAVE, B01	2.43	0.019
TIME slope, P1		
INTRCPT2, B10	0.84	0.230
MLEAVE, B11	-0.66	0.006

workplace maternity leave benefit, but that scores significantly decreased ($p < 0.006$) with time across waves in those same subjects, indicating a potential positive benefit of the policy on one of the more substantial work stress scales. Additionally, outcomes were significantly related to trajectories of overcommitment across time; Table 7 demonstrates a significant effect of overcommitment on scores for self-rated fatigue, showing both higher initial values and a positive slope (increase across 4-waves of interview) with further evidence that baseline values (intercepts) are modified by race/ethnicity, though the slope, is not. Finally, overcommitment is associated with initial increased scores on maternal diastolic BP, though an increase across time waves with increasing scores is not present (Table 8).

Table 7. Multilevel regression of trajectories of fatigue associated with overcommitment across time: Ethnicity as level-2 variable

Fixed Effect	Coefficient	P-value
INTRCPT2, B00	59.8	0.001
Ethnicity, B01	8.1	0.03
slope, OVERCOM	0.73	0.44
Ethnicity, B11	0.15	NS

Table 8. Multilevel regression of diastolic BP associated with overcommitment across time: Adjusted for age as level-2 variable

Fixed Effect	Coefficient	P-value
INTRCPT2, B00	70.8	0.001
Age, B01	0.42	0.17
slope, OVERCOM	0.15	NS
Age, B11	-0.05	0.09

Additional analyses are pending, having awaited the full dataset to begin; however the preliminary data outlined here suggests significant ability to examine questions of the interaction of fixed work characteristics with trajectories of workplace stressors and stress measures.

Overall Conclusions:

The results presented here represent successful completion of a project to perform repeated measures of workplace stressors, in particular assessing the use of the Effort-Reward Imbalance model and compare this to the Demand-Control Model of Karasek et al. A significant problem was overestimation of our ability to recruit women early in the first trimester of pregnancy (12 weeks or less; some expansion of effort in the realm of advertising and promotion of the work did allow increased recruiting, but an additional year was needed to recruit the number of subjects shown here, which was still below estimated goals. The likely explanation for this is the lack of prenatal care in the early stages of the pregnancy, which made recruitment through maternity clinics and physicians' offices highly problematic, since most women are not given an appointment for prenatal care until at least 12-15 weeks gestation, and many prospective callers had to be disqualified on gestational age criteria. Had the requirements been relaxed to 15-18 weeks it is likely that a greater number of subjects would have been successfully recruited. Despite lower recruiting, the proportion of subjects completing the four sets of interviews was higher (80%) than our estimated figure (65-70%) which was based on the probabilities of loss to follow-up and miscarriage.

Despite recruitment difficulties, a broad spectrum of working women in Connecticut was obtained for study. Overall the subjects were the same age and the same racial/ethnic composition as has been noted by the state's birth registry. Subjects were somewhat better educated than the overall source population.

Of interest, the psychometric properties of the Effort-Reward Imbalance model were exceptionally good, with Cronbach's alpha uniformly greater than 0.7 for all scales of the model; this contrasted with the scores for job control, which were under 0.4. This may reflect, as in our earlier work, the fact that the ERI model is of greater measurement validity in a service economy, contrasted with the Demand-Control model and its origins in an economy more weighted to manufacturing. Subject scores on the ERI model showed a decline across time during pregnancy, with a concomitant increase in job control (non-significant) and no change in effort-reward imbalance across pregnancy.

The possibility of a critical period through which occupational psychosocial stressors act is given credence by these results. In accordance with theory on this subject, we find that correlations between intermediate outcome variables related to pregnancy outcomes (blood pressure, self-rated fatigue), and occupational psychosocial stressors are greatest and statistically significant at the second measurement wave, corresponding to mid-pregnancy and the timing of early fetal growth. We find much weaker correlations with occupational psychosocial variables and actual birth outcomes, especially birth weight, although this is not surprising since: a) the range of factors associated with these outcomes may be broader and less susceptible to these factors; and b) the study was not designed with sufficient power to specifically test this hypothesis, a considerably greater number of subjects would need to be enrolled to have any possibility of testing this. Longitudinal effects of overcommitment on time trends in these intermediary variables are however significant, as demonstrated above using self-rated fatigue as an outcome variable. In sum, these results are in accord with a modest effect of overcommitment on the health of women subjects, and do point to the possibility that work characteristics may affect intermediate health endpoints that have modest consequences on fetal growth and development.

Of additional interest are substantial differences in occupational characteristics between blacks and white/Hispanic subjects. These self-rated job characteristics parallel the PI's recent findings of similar differences in objectively-rated (ie not by the worker-subjects) work characteristics, which also show lower values in blacks once adjusted for age and education. That these values are similar to whites, or higher, in Hispanics (and are persistently higher, or improve with adjustment for education) suggests differential access to higher-quality or less stressful work despite equivalent levels of education, and is likely in part explanatory of the findings of several past studies noting higher risk for adverse birth outcomes in college-educated black mothers versus both college-educated whites and blacks without a college degree. This may inform the design of future studies which should encompass measurement of factors such as economic barriers and discrimination that would provide potential explanatory data for both findings related to occupational trajectories and outcomes related to long-term differentials in health consequent to work factors.

In summary, these findings from the R-21 Preliminary/Planning grant may be of substantial value in the planning of more formal targeted and larger scale studies that can be designed to measure the effect of working conditions and occupational psychosocial stressors on birth and perinatal outcomes.

Publications resulting from grant support:

Meyer JD, Warren N, Reisine S. Racial disparities in low birth weight delivery associated with maternal occupational characteristics. Am J Ind Med [2010] Feb;53(2):153-62.

Inclusion of gender and minority study subjects:

TARGETED/PLANNED ENROLLMENT: Number of Subjects			
Ethnic Category	Sex/Gender		
	Females	Males	Total
Hispanic or Latino	7	0	7
Not Hispanic or Latino	54	0	54
Ethnic Category Total of All Subjects	61	0	61
Racial Categories			
American Indian	0	0	0
Asian	0	0	0
Native Hawaiian or Other Pacific Islander	0	0	0
Black or African American	8	0	8
White	53	0	53
Racial Categories: Total of All Subjects	61	0	61

Inclusion of Children: Although children were not excluded from participation in the study, no subjects were enrolled who were less than 21 years of age during the course of the study