Work Hours Affect Spouse's Cortisol Secretion—For Better *And* for Worse

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Objective: In a sample of 52 German dual-earner couples with at least one child under age 5, we examined the bodily costs and benefits of the amount of time each spouse spent on productive activities. **Methods:** Diary reports of time allocated to formal and informal work activities were analyzed according to the Actor-Partner Interdependence model. **Results:** Hierarchical linear models showed that each hour an individual allocated to market, as well as household work, increased his or her total cortisol concentration (by 192 and 134 nmol/l, respectively). Unexpectedly, the time the spouse allocated to paid work also raised an individual's total cortisol concentration (by 64 nmol/l). In line with our expectations, there was a tendency for the time the spouse allocated to household work to decrease the individual's cortisol concentration (by 81 nmol/l). **Conclusions:** This study contributes to the body of evidence on the complex nature of social relationships and complements the literature on specific working conditions and couples' well-being. **Key words:** cortisol secretion, marriage, partner effect, quantitative workload.

INTRODUCTION

Being married has beneficial effects on an individual's well-being and life expectancy (1,2), and men benefit much more from marriage than women do (3,4). Several explanations for these health benefits have been proposed, but the underlying processes are far from being understood. Social support by the spouse seems to be a significant factor (5). It can consist of practical assistance with activities and problem solving, emotional support, or assistance with the appraisal of environmental conditions and can have direct and indirect, stress-buffering effects (6). Among the direct effects of social support is an alteration of the neuroendocrine risk profile (7), which could, over time, contribute to interindividual differences in health and longevity. Most of the evidence was based on perceived availability of support (8). The measures employed in these studies reflect the emotional component of support, but we argue that it is equally important to look at actual instrumental support. The present study capitalizes on the actual performance of instrumental support between marriage partners. Support activities which are performed on a daily basis and, therefore, possess the potential for small but accumulating positive effects on the spouse's neuroendocrine regulation (9) are housework activities.

Previous research shows that activities performed by the spouse do not have exclusively positive effects on the respective individual and that women are particularly exposed and vulnerable to these negative effects (10–12). With regard to paid work activities performed in the labor market, it has been well documented that stress of one spouse influences not only his or her own strain as indicated by the secretion of cortisol (13) but also the other spouse's strain through interindividual transmission processes (14). Typically, these studies focused on specific characteristics of the productive activities such as the control they afford and often neglected those kinds of productive activities that do not yield financial compensation, such as household work. Accordingly, it has not been investigated what role the mere quantity of work hours an individual performs on and off the job has in relationship to a person's own level of strain and that of his or her spouse.

Productive activities require a mobilization of energy by the individual who performs them, and this is reflected in his or her cortisol secretion (15). For the spouse's work activities, however, the individual does not have to mobilize any energy except for that resulting from additional workload. Furthermore, because the mobilization of energy for work activities is not mediated by affect, this kind of physical strain cannot be transmitted to the spouse in the course of marital interactions. Hence, we assumed that an individual's market work would be positively related to his or her cortisol secretion but that the respective spouse's market work would not be associated with the individual's hormone secretion over and above the expected individual level effects of work hours. With respect to an individual's household work, we expected that cortisol secretion increases with the amount of time spent on those activities. Between partners, however, we expected that the performance of household activities by a spouse constitutes instrumental support, leading to a decrease in the individual's cortisol secretion.

The goal of this study was to examine the bodily costs and benefits of the time both spouses allocate to productive activities (formal ones, i.e., market work, and informal ones, i.e., household work (16)), as indicated by their total cortisol concentration. We extended existing evidence in three ways. a) With the number of work hours an individual performs, we utilized a quantitative measure of work demands. b) With the number of housework hours the spouse performs, we utilized a measure of actual instrumental support. c) With total cortisol secretion, we utilized a measure of strain that is not contaminated by reporting biases.

Testing the effects of a couple's productive activities requires relating a) partner A's allocation of time to market and household work and b) partner B's allocation of time to market and household work to both partners' cortisol concentration. Dyadic data are not independent, and this property contributes to the richness of these data, but it also poses problems with regard to the choice of an adequate data analytic strategy. Kashy and Kenny's (17, see also 18–20) Actor-Partner Interdependence model seems to be the adequate analytic tool. The model uses the dyad as the unit of analysis and allows researchers to estimate simultaneously the effect of an individual's characteristics on his or her own score on the dependent variable (actor effect) and on

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the partner's score on the dependent variable (partner effect). The partner effect from the Actor-Partner Interdependence model directly models the mutual influence that may occur between individuals in dyadic relationships. With this model, it is possible to estimate the effect of Partner A's and Partner B's time use on Partner A's and Partner B's cortisol concentrations.

METHODS

Participants

Fifty-two dual-earner couples participated in the study. In return for their participation, participants received individual feedback on their time use and took part in a lottery to win a weekend in a nice hotel in the vicinity of Berlin, including dinner and child care arrangements. Participants had an average age of 37 years (SD = 4.9), and their number of children ranged from one to four, with a mean of 1.7. Most participants were married (84%); the remainder were cohabiting. Ninety percent held a university degree; 10% had received other vocational training after 13 years of schooling. For both men and women, average work weeks ranged from 20 to 40 hours, according to their work contracts; 58.5% of the men and 32.1% of the women earned more than Euro 25,000 (about 30,500 US dollars) of gross yearly income.

Procedure

The empirical investigation consisted of two parts, which took place between January and November 2003. First, employed parents answered an internet questionnaire containing sociodemographic characteristics. A week later, both partners participated in a 6-day intensive time-sampling phase, beginning with a visit of a research assistant to participants' home, during which she explained the use of the time-sampling device, a handheld Psion computer (Psion PLC, London), and supervised responses to one simulated signal. In the course of each of the 6 days (between 9:30 AM and 9:30 PM), both partners simultaneously received five signals separated by intervals of approximately 3 hours. Signal-contingent questionnaires presented via handheld computer sampled the activities performed at the moment of the signal. In addition, those activities performed during the time interval between the previous and the current signal were recorded via paper booklet containing a timeline with ninety-six 15-minute intervals (e.g., 5:00, 5:15, 5:30). For the current purpose, we used aggregates of the continuous activity recordings.

Taken together, answering the questions took 5 to 7 minutes per measurement occasion. For the activities performed after the last signal, an additional prompt was given the next morning after waking up so that all the activities of the waking day were recorded continuously. Parallel to questionnaire completion, a saliva sample for the determination of the level of free cortisol was taken.

At the time the study was conducted, the Technical University of Berlin did not have an institutional review board. Hence, each individual research unit was responsible to ensure that studies were conducted in line with psychological and medical ethic guidelines. We hereby assure that we conducted this study in accordance with the current ethical guidelines of the social/behavioral and biomedical sciences.

Selectivity of the Sample

Employed parents were recruited by advertisements in local newspapers, information leaflets at pediatrician offices, and through public and private organizations in Berlin. Out of a total of 133 couples who called in, 42 (32%) ended up not participating mainly because of time constraints for one partner. Twenty-three couples (17%) had to be excluded because they had illnesses or took medication known to affect cortisol regulation; 15 (11%) dropped out before the time-sampling phase; and one study participant (0.8%) did not answer the final internet questionnaire. Not a single couple dropped out in the course of the time-sampling phase.

Measures

Daily Activities

For their time-use reports, participants used a coding scheme distinguishing between five activity categories, with 5 to 8 subcategories each (market work, leisure, household work (including shopping, preparing meals, cleaning, doing laundry, maintaining house and garden), childcare, personal activities). From the continuous time-use recordings, we computed the following time-use indices across the 6 sampling days: a) total duration of market work (in hours) and b) total duration of household work (in hours).

Saliva Cortisol

Saliva cortisol is a reliable indicator of free cortisol in plasma considered to be the biologically active portion of the hormone (21). To collect saliva parallel to the completion of the questions with the aid of the pocket computer, participants chewed on a cotton roll for about 1 minute. The roll was placed in a capped plastic vial (Salivette, Sarstedt, Rommelsdorf, Germany), which subjects stored in their home freezers as soon as possible, that is, for some samples only after returning from work. After completing the questionnaire, participants had to indicate the number of the vial they had used. At the end of the sampling period, uncentrifuged samples were stored at −20°C in the deepfreeze units of the Max-Volmer-Institute of Biophysical Chemistry and Biochemistry at Berlin University of Technology until analysis. Compliance with saliva sampling was good; only 5.5% of the Salivettes were either missing or did not contain enough saliva for the analysis. Cortisol concentration was determined with a commercial immunoassay with chemoluminescence detection (CLIA, IBL-Hamburg, Hamburg, Germany (22)). This assay has a lower detection limit of 0.4 nmol/l, with intra- and interassay coefficients of variation of less than 8%. All samples from a couple were analyzed in the same assay to reduce sources of variability. Within the present study, we investigated total cortisol concentration computed through the area under the curve using the trapezoid formula (23).

Furthermore, smoking, exercise, body mass index, and sleep duration and quality had to be assessed as control variables because they are known to affect cortisol regulation (21).

Smoking

Participants indicated whether and how frequently they smoked: 82.1% reported to be nonsmokers, 13.2% to smoke occasionally, and 4.7% to smoke regularly. This information was dichotomized into smokers and nonsmokers and served as a control variable.

Exercise

The time recorded in the time-use reports within the category "physical exercise" was aggregated across the 6 days of time sampling. It ranged from 0 to 9 hours [mean (M) = 0.97 hours].

Body Mass Index

Participants were asked to report their height and weight. Body mass indices were calculated by dividing participant's weight in kilograms by the square height in meters. Body mass indices ranged from 17 to 33, with a mean of 24.

Sleep Duration

Each morning, study participants indicated when they had fallen asleep and when they had waken up. Average sleep duration during time in study was 424.59 minutes (SD = 69.17).

Sleep Quality

Sleep quality was assessed every morning by asking study participants to indicate how well they had recovered in their sleep on a 5-point Likert-type scale, ranging from "did not recover at all" (1) to "fully recovered" (5). Average sleep quality was 3.58 (SD = 1.01).

Analytic Strategy

For modeling the substantive hypotheses, we employed actor-partner interdependence models for all the dependent variables within a multilevel

framework (17,24,25). As a reference model, we used a model which contained only control variables. The effect of workload on cortisol concentration was represented in the following model, with the actor's cortisol score as dependent variable and actor's and partner's time allocated to market work and housework as grand-centered individual-level predictors:

$Y_{ij} = \beta_{0j} + \beta_{1j}$ (Market Work Actor) + β_{2j} (Market Work Partner) + β_{3j} (Housework Actor) + β_{4j} (Housework Partner) + r_{ij}

In the couple-level model, only the intercept was allowed to vary across couples. For reasons of parsimony (25), we set all other residual parameter variances to zero.

$\beta_{0j} = \gamma_{00} + u_{0j}$
$\beta_{1j} = \gamma_{10}$
$\beta_{2j} = \gamma_{20}$
$\beta_{3j} = \gamma_{30}$
$\beta_{4j} = \gamma_{40}$

RESULTS

Descriptive Information

Table 1 displays the intercorrelations between predictors and criterion, as well as their sex-specific means and standard deviations. Women and men did not differ with respect to the number of hours allocated to housework, total cortisol concentration, and sleep quality. However, men as compared with women allocated more hours to market work, had a greater body mass index, and had a lower average sleep duration. Household work was negatively related to time allocated to market work.

With regard to our hypotheses, we found an individual's cortisol secretion to be affected not only by the mere quantitative load resulting from work activities he or she performed in the labor market or at home but also by the quantity of his or her spouse's work activities. For reasons of clarity, we report separately the effects of market and household work that are estimated simultaneously by our model.

Effect of Market Work

As expected, we found the time devoted to market work to be positively associated with an individual's cortisol secretion (Figure 1). With each hour an individual allocated to market work, his or her average daily cortisol secretion of 6,666 nmol/l increased by 192 nmol/l (SD = 32). Contrary to our expectation, in addition to his or her own market work, also spouse's market work affected individual's cortisol concentration. With each hour a spouse allocated to market work above average, the individual's average cortisol secretion increased by 64 nmol/l (SD = 22).

Effect of Household Work

With regard to household work, we found the expected divergent effects for individual and spouse. With each hour of household work performed above average, the individual's average cortisol secretion increased by 134 nmol/l (SD = 42; Figure 2). The size of the effect is smaller than for market work, but the

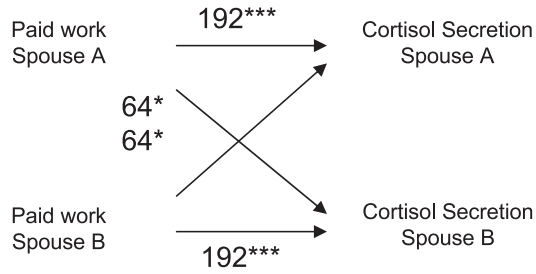

Figure 1. Daily cortisol secretion as function of hours allocated to paid work. Six times per day, the level of free cortisol was assessed. The figure shows the change in daily cortisol secretion as a function of the hours of paid work one spouse performed above average and of the hours of paid work the other spouse performed above average.

TABLE 1. Hours of Market and Household Work, Total Cortisol Secretion, and Control Variables: Correlations, Sex-Specific Means, and Standard Deviations ($N = 52$)

Variables	1	2	3	4	5	6	7	8	Male Spouse		Female Spouse		Sex Difference,
									M	SD	M	SD	*T*
1. Market work (h)	—								37.27	10.86	30.33	8.90	2.43*
2. Household work (h)	−0.42***	—							13.31	6.74	15.82	6.71	−1.26
3. Cortisol (AUC, nmol/l)	0.13	−0.07							6,493.61	246.06	6,890.66	194.68	−1.20
4. Sex	−0.34**	0.18	0.08										
5. Regular smokers (yes/no)	−0.02	−0.02	−0.08	−0.07									
6. Physical exercise (h)	−0.18	0.20	−0.11	0.10	0.03				0.84	0.30	1.12	0.79	−1.00
7. Body mass index	0.09	0.04	0.25*	−0.35*	0.05	0.15			24.62	0.38	22.49	0.48	3.13**
8. Sleep quality	−0.02	−0.05	−0.08	0.02	0.01	−0.02	0.01		3.56	0.10	3.60	0.09	0.14
9. Sleep duration (min)	−0.06	−0.11	0.02	−0.04	0.11	−0.18	0.08	0.24*	417.17	54.21	432.33	54.03	−2.20*

AUC = area under the curve.
* $p < .05$, ** $p < .01$, *** $p < .001$.
There were 3 men smokers and 2 women smokers.

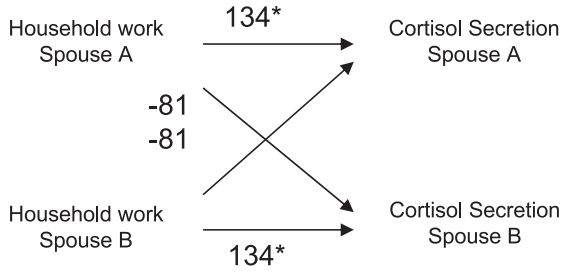

Figure 2. Daily cortisol secretion as function of hours allocated to household work. Six times per day, the level of free cortisol was assessed. The figure shows the change in daily cortisol secretion as a function of the hours of household work one spouse performed above average and of the hours of household work the other spouse performed above average.

underlying processes are expected to be comparable. In line with our expectations, the effect of spouse's housework on individual's cortisol secretion had a reversed sign. With −81 nmol/l (SD = 72), the effect of spouse's housework on individual's cortisol secretion was even bigger in size than the effect of spouse's market work but did not reach the conventional level of significance.

The fully unconditional model revealed 74% of the variance to originate at the day level, 20% at the individual level, and 6% at the couple level. The predictors accounted for 21% of the unconditional intraperson variance. The deviance reduction was highly significant ($\chi^2 = 178.09$, p <.001, $df = 10$).

DISCUSSION

In a sample of professional dual-earner couples with at least one child under age five living in the area of Berlin, Germany, we investigated the effects of the time individuals (actors) and their spouses (partners) allocated to market and household work on both spouses' total cortisol concentration.

As expected, we found the mere quantitative workload of an individual resulting from market, as well as household work, to be associated with his or her cortisol secretion. Our results confirm the notion that the secretion of free cortisol reflects the energy that has to be mobilized when performing work activities (15). They are consistent with the results of Lundberg and Hellström (26), who reported an association in women between the amount of overtime at work and a different cortisol measure, that is, increased levels during the first hour after awakening.

With regard to spouse's work hours, we found two divergent effects. Contrary to our expectation, spouse's market work increased individual's cortisol concentration. Because this finding cannot be explained by energy mobilization, the underlying processes may be more complex and may have several possible explanations, three of which will follow. a) We suggest that the individual may perceive the spouse's allocation of time to market work as a threat to his or her goal pursuit and achievement and, hence, as a stressor (27). A lack of control or predictability regarding the spouse's time allocation may aggravate this effect (28), but we did not assess whether this was the case. b) A side effect of long working hours is the reduced amount of time available for positive marital interaction or mere copresence (10), possibly diminishing the beneficial effects of marriage on neuroendocrine regulation. c) Finally, the individual could be distressed because of the spouse having to work so hard. It is important to point out that the effect was not mediated via negative affect because affect was not associated with hours allocated to market work ($\beta_{2j} = -0.0021$, n.s.). To our knowledge, this interesting partner effect has not been shown before; it has to be replicated in other samples of working parents, therefore, before we can establish it.

In line with our expectations, the time the spouse allocated to housework tended to decrease individual's cortisol concentration. Because of the small sample size, the study possessed only limited power, that is, a high probability of Type II error. Therefore, rather than concluding that there is no effect of social support, we should focus on the size of the coefficient we obtained, and it is considerable (29).

The results show housework to be an instance of instrumental support, with a beneficial effect on the individual's cortisol secretion. We suggest two possible explanations for this effect. a) The effect could be a direct one in that the individual experiences the spouse's allocation of time to household work as support of his or her pursuit of personal goals (27). b) It may also be an indirect one, mediated by the social appreciation that is expressed by positive support activities and that strengthens social ties (7,30). The fact that men and women were equally affected by their spouses, in our study, may be a consequence of the egalitarian way in which these couples lead their relationships. It could as well be a general effect of the predictor time use, which is rather independent of subjective perceptions and evaluations; this remains to be investigated in future studies.

Strengths and Limitations

The strengths of this study include the sampling of couples and the reliable assessment of their time use with a repeated diary method. The measure of strain, total cortisol concentration, was not contaminated by reporting biases. One other strength, the high selectivity of the sample, can also be seen as a limitation because it limits generalizability to couples of other social strata. Finally, on the basis of our data, we cannot reach a conclusion regarding the underlying processes. Therefore, the given explanations are not much more than speculations.

CONCLUSION

In our study on time use of dual-earner couples, we showed an individual's total daily cortisol concentration to be affected not only by the quantity of work activities he or she performed but also by the quantity of his or her spouse's work activities. With every hour of market work the spouse performed above average, the individual's total cortisol concentration increased, and with every hour of housework, it decreased. Taken together, this pattern of results shows that a spouse can have positive and negative effects, depending on his or her concrete

use of time. Whereas in our egalitarian sample we did not find any gender differences, the division of labor in traditional marriages may have contributed to the differential health effects of marriage for men and women. The findings add to the corpus of literature on the complex nature of social relationships (31,32) and complement existing evidence on the effects of specific working conditions on couples' health and well-being (33).

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