Effects of Work Overload and Burnout on Cholesterol and Triglycerides Levels: The Moderating Effects of Emotional Reactivity Among Male and Female Employees

Arie Shirom, Mina Westman, and Ora Shamai
Tel Aviv University

Rafael S. Carel
Ben-Gurion University of the Negev

The effects of objective and subjective overload, and of physical and emotional burnout, on cholesterol and triglycerides levels were studied in a quasiprospective design. The possible moderating effects of emotional reactivity on these relationships were also investigated. The study's hypotheses were tested separately for male and female employees. Time 1 (T1) data were collected from 665 healthy employees (30% women) while they were undergoing periodic health examinations in a health-screening center. Time 2 (T2) measures of cholesterol and triglycerides were collected 2 to 3 years after T1. The hypotheses were tested by regressing each T2 criterion on its T1 level; the control variables of age, obesity, diet, alcohol consumption, and smoking; and the other predictors. For female employees, the T2–T1 changes in the serum lipids were positively predicted by emotional burnout, as expected, but negatively predicted by physical fatigue. For male employees, both types of T1 burnout were positive predictors of the T2–T1 change in total cholesterol.

A recent review of the literature on lipid changes during and after stressful experience (Niaura, Stoney, & Herbert, 1992) concluded that future research should focus on the mechanisms through which stress influences lipid concentration. This research was designed to elucidate possible pathways leading from overload and burnout to high levels of serum lipids among Israeli employees. The relationship between lipid metabolism and the development of coronary heart disease (CHD) has been amply documented (e.g., Artaudwild, Connor, Sexton, & Connor, 1993; Kannel & Wilson, 1992; NIH Consensus Conference, 1993), including in Israel (Goldbrout, Yaari, & Medalie, 1993). Thus, an evaluation of the extent to which job-related overload and burnout among Israeli employees constitute risk factors in the etiology of high serum lipids levels might have implications also for workplace-based preventive strategies.

We focus on two types of serum lipids: total cholesterol and triglycerides. Elevated concentration of each has been shown to be independently associated with increased risk of CHD (Brindley, McCann, Niaura, Stoney, & Suarez, 1993). Their levels have been shown to be influenced by several factors, including heredity, gender, body mass, dietary intake of fat, physical activity, and cigarette smoking (NIH Consensus Conference, 1993; Rosenman, 1993a). However, it has been noted that all of the above factors combined account for only a small fraction of the variability of these serum lipids. This has prompted a continuous research effort aimed at exploring the possible role of psychosocial stress. Dimsdale and Herd (1982) and Niaura et al. (1992) in their reviews of the literature on this subject concluded that there was some evidence, albeit inconsistent, implicating objective or perceived stress as a source of elevated levels of total cholesterol, and suggested several physiological and behavioral mechanisms to account for the relationships. Dimsdale and Herd (1982) noted that the levels of triglycerides also increased in response to psychosocial stress, although more slowly.

Our research adds three new features to the body of literature on the relationship between psychosocial stress and serum lipids:...
stress and serum lipids. First, with very few exceptions, past research has been concerned with episodic, or event-based stress (Dimsdale & Herd, 1982; Melamed, 1994; Niaura et al., 1992). Event-based and ongoing, chronic exposure-based conceptualizations of stress derive from differing theoretical approaches (Derogatis & Coons, 1993) and have often been found to be differently related to physiological risk factors in CHD (Kahn & Byosiere, 1992), including elevated serum lipids (Kasl, 1984). The relationship between total cholesterol and CHD is known to be graded and continuous (Niaura et al., 1992). To illustrate, in the Framingham Heart Study, for every 1% reduction in serum cholesterol, there was a 4% reduction in CHD risk, controlling for other risk factors, such as age, obesity, and blood pressure (NIH Consensus Conference, 1993). This dose–response relationship suggests that an individual’s continuous exposure to psychosocial stress may be implicated in the etiology of CHD by means of the elevated levels of cholesterol and possibly also triglycerides. Studies of specific types of chronic stress, including occupational instability and job insecurity, have shown that these stresses were implicated in elevations of total cholesterol (Mattiasson et al., 1990; Siegrist, Matschinger, Cremer, & Seidel, 1988). These studies reported that the elevated concentrations of cholesterol persisted as long as the stress was present, often for 1 or 2 years (Mattiasson et al., 1990; Siegrist et al., 1988). Therefore, the study of chronic stress–serum lipids relationships is theoretically meaningful and fills a gap in the literature.

The second new feature of our study involves the introduction of burnout, representing emotional and physical strain or a reaction to stress, as a possible mediator of the effects of both subjective and objective overload on the two serum lipids. Overload has been shown to be the most important predictor of burnout (Brantley, 1993; Shirom, 1989). Since Appels and Schouten (1991) showed that burnout is an independent risk factor in CHD, the search for the mechanisms linking burnout and CHD has continued (e.g., Melamed, Kushnir, & Shirom, 1992). This research provides yet another link in that effort by focusing on the possibility that burnout is related to CHD by means of its effects on the two serum lipids under consideration here.

The third feature of our study involves the moderating role of a personality predisposition, emotional reactivity, on the above set of relationships. It has been suggested that serum lipids may be more elevated when a person has a propensity to be emotionally aroused by various environmental cues (Melamed, 1994). In a similar vein, recent research (Greene, Houston, & Holleran, 1995; Muller, Rau, Brody, Elbert, & Heinle, 1995) has suggested a certain physiological mechanism that may explain the unfavorable lipid profiles of individuals who are predisposed to prolonged emotional activity, such as those with a predominantly aggressive anger coping style. Therefore, we explored the possibility that the expected effects of burnout on serum lipids may be further enhanced when individuals were characterized by high emotional reactivity. The above mechanisms were studied in relation to the criteria defined as changes in the levels of serum lipids over several years, thus obviating the need to account for problems of reverse causation from serum lipids (or atherosclerotic processes related to them; see Howard, Cunningham, & Rechmitzer, 1986) to subjective reports of overload and burnout.

The Research Model and Variables

In Figure 1, each of the study’s hypotheses is represented by an arrow. The criteria were changes in the levels of cholesterol and triglycerides that occurred, on the average, over a 2- or a 3-year period. The three panels on the left of the criteria represent the major groups of predictors. The broken arrow leading from age, diet, smoking, alcohol consumption, and body mass index to the criteria indicates that these were the control variables used in the study. These variables were controlled for in the analyses, following evidence indicating that they affect the levels of serum lipids (Fried, 1988).

Stress was defined as a condition subjectively experienced by individuals who identify an imbalance between demands addressed to them and the resources available to them to encounter these demands (Lazarus, 1990). Job stress was defined in the present study in terms of role demands originating in the role environment. Subjective job overload (abbreviated as overload) represents a condition in which individuals perceive themselves as having insufficient time or energy to meet the quantity of job-related demands imposed upon them (French, Caplan, & van Harrison, 1982). We decided to focus on this type of job stress because it was found to be the most prevalent type of chronic stress in work organizations (French et al., 1982; Kaplan, 1990; Karasek & Theorell, 1990). Objective overload refers to the quantitative aspects of the demand, as tapped independently of the individual’s perception of it (French et al., 1982).

Strain refers to the physical, psychological, and
behavioral responses of the person in the face of stress. In the present study, we investigated a unique type of strain, burnout. Burnout has been defined as a syndrome characterized by physical, mental, and emotional exhaustion, often accompanied by depersonalization and diminished personal accomplishment (Cordes & Dougherty, 1993). Following the multidimensional conceptualization of burnout proposed by Shirom (1989) and Hobfoll and Shirom (1993), we made the distinction between physical fatigue, representing a feeling of chronic exhaustion or lassitude, and emotional burnout, denoting a feeling of being emotionally drained, a feeling of wear and tear related to a person’s emotional resources. Theoretical and empirical support for this conceptualization of burnout, which views exhaustion as representing the only intrinsic dimension of burnout, were provided in several recent studies of burnout in nonhuman service samples (Evans & Fischer, 1993; Garden, 1987; Lec & Ashforth, 1993).

Emotional reactivity is a personality disposition proposed by Melamed (1987) to represent a person’s proneness to easily enter into and sustain a state of emotional arousal in response to, or in anticipation of, emotionally laden events (Melamed, 1994). In terms of cognitive self-regulation theory (Carver & Scheier, 1981), emotional reactivity denotes reported inefficacy in the self-regulation of thoughts and images and the resultant emotions in anticipation of, during, and following emotional events. Although emotional reactivity is a relatively new construct, its predictive and construct validity has been established in a number of studies (Melamed, Kushnir, & Shirom, 1992).

We followed other researchers (cf. Baruch, Biener, & Barnett, 1987; Jick & Mitz, 1985) in postulating gender differences in the effects of stress, strain, and emotional reactivity on total cholesterol and triglycerides. Therefore, we formulated each of the major hypotheses separately for male and female employees. The theoretical rationale for expecting this difference follows. First, gender has been shown to be a critical demographic factor determining a person’s range and intensity of exposure to overload and burnout (Frankenhaeusser et al., 1989; Jick & Mitz, 1985; Pines, Aronson, & Kafry, 1981). Thus, gender-related socialization practices influence the intensity of emotional arousal following exposure to stress; the predisposition to experience emotional burnout and report physical exhaustion is sex-linked, and experiences of work overload, objective and subjective, are gender-specific (Baum & Grunberg, 1991; Sorensen & Verbrugge, 1987). Second, there are sex-specific life-span changes in cholesterol, like those that result from menopause, and higher levels of total cholesterol have been found for men relative to women in the USA (e.g., Sorensen et al., 1985), in Sweden (Frankenhaeusser et al., 1989), and in Israel.
(Green, Jucha, & Peled, 1992). Third, systematic gender differences in the effects of subjective and objective workload on self-assessed health status and somatic complaints have been reported for a representative sample of Israeli employees (Lewin-Epstein, 1989). Gender differences in the effects of stress on total cholesterol have been reported in several studies (van Doornen & van Blokland, 1987, 1989), though other investigators failed to find them (Niaura et al., 1992). We did not consider the results of the meta-analytic review of Martocchio and O’Leary (1989) to be relevant to this assumption, because not a single study reviewed in their meta-analysis included either workload or serum lipids.

The Effects of Overload on Serum Lipids (Hy 1)

Our first hypothesis (Hy 1) dealt with the effects of (subjective) overload on serum lipids. Chronic overload may affect serum lipids by means of the mechanism of high arousalability (Rosenman, 1993a). An employee with an ongoing, recurrent overload at work may be exposed to heightened activity of the endocrine system, involving secretion of corticosteroids, which are known precursors of serum lipids (Frankenhauser, 1986; Stein & Miller, 1993). As recent reviews of the literature indicate, both objective and subjective (perceived) stress can bring about significant and occasionally large increases of serum cholesterol (Niaura et al., 1992; Perkins, 1989; Rosenman, 1993a). In two longitudinal studies, subjective and objective overload have been shown to affect cholesterol concentrations (McCann, Warrick, & Knopp, 1990; Siegrist, Matschinger, Cremer, & Seidel, 1988). Following this evidence, we hypothesized (Hy 1) that the higher the levels of overload, the more pronounced the subsequent elevations of serum lipids, and that (Hy 1a) these effects will be stronger for subjective than for objective overload.

The Effects of Burnout on Serum Lipids (Hy 2)

The second hypothesis (Hy 2) had to do with the effects of overload, emotional burnout, and physical fatigue on serum lipids. Our hypothesis is based on evidence that burnout tends to reflect an employee’s exposure to the more threatening, uncertain, or unpredictable job stresses (Hobfoll & Shirom, 1993; Shirom, 1989). We hypothesized (Hy 2a) that the higher the levels of burnout and fatigue, the more significant the subsequent elevations of serum lipids. Relative to fatigue, we expected emotional burnout to have a more pronounced effect on subsequent elevation of serum lipids for both female and male employees (Hy 2a). Both types of burnout represent states of depletion of personal coping resources that may occur with heightened arousal at work. Hobfoll (1989) claims that people strive to retain, protect, and build resources and that what is threatening to them is the potential or actual loss of these valued resources. Following Hobfoll’s (1989) reasoning, we considered that it would be considerably more difficult to replenish depletion of emotional resources than to reverse physical burnout; hence their hypothesized differential impact on serum lipids (Hy 2a).

In their attempt to explain the lack of support for the association of chronic stress and serum lipids in past research, Niaura et al. (1992) noted it may be unreasonable to suppose that stress, such as job overload, will have significant effects on these lipids unless it clearly taxes the limits of coping capacity. Burnout and fatigue could be regarded as indices of the latter type of stress encounters. Following the above rationale, we expected that burnout will only partially mediate (Baron & Kenny, 1986, p. 1176) the effects of overload on elevations of serum lipids (Hy 2b).

For female employees, we hypothesized (Hy 2c) more pronounced direct and mediating effects of burnout and fatigue on serum lipids, relative to male employees, following findings indicating that for female employees burnout is a more powerful predictor of health outcomes (Hobfoll & Shirom, 1993; Shirom, 1989).

The Effects of Emotional Reactivity on Serum Lipids

One of the mechanisms explaining the findings that stress leads to elevations of serum cholesterol has been that of stress-induced emotional anxiety. When encountering subjective stress, the level of activity of the sympathetic nervous system increases (Rosenman, 1993b). High levels of sympathetic arousal have been associated with enhanced cardiovascular reactivity and higher levels of total cholesterol (Fredrikson, Lundberg, & Tuomisto, 1991). This rationale has led us to hypothesize (Hy 3) that higher levels of emotional reactivity will be associated with subsequent elevations of serum lipids and that (Hy 3a) these effects will be more pronounced among female than male employees.

The fourth hypothesis (Hy 4) was formulated in terms of the moderating effects of emotional reacti-
ity on the relationships between burnout and serum lipids. It has been reported that states of behavioral activation tend to be associated with more sustained effects of stress on cholesterol levels (Rosenman, 1993a). Employees with high levels of emotional reactivity are likely to experience the intrusion of memories of emotionally laden events that may, in turn, cause disruptions in their physiological coping mechanisms, like elevated catecholamine secretion during relaxed periods at work. Following this rationale, we hypothesized (Hy 4) that for higher levels of emotional reactivity, burnout will be associated with larger subsequent increments in serum lipids, and that (Hy 4a) these effects will be larger for female than for male employees.

Method

Respondents

Respondents in this study were 665 employees who underwent comprehensive health examinations in one of Israel's largest screening centers, located in the Tel Aviv metropolitan area. They were referred to the screening center by their employers for periodic or pre-employment health examinations. Respondents no longer gainfully employed (e.g., retirees or the unemployed) or those who were referred to the center by a physician because of suspected physical or mental health problems were not asked to participate in the study. Because in this study we sought evidence of the effects of stress and strain on cardiovascular disease (CVD) risk, as tapped by elevated levels of serum lipids, and not vice versa, the very few (n = 19) employees with either self-reported or center physician diagnosed chronic disease, including diabetes, hypertension, and all categories of CVD, were omitted from the final sample.

The screening center uses automatic multiphasic health testing and maintains a fairly large computerized database on examinees (Carl & Leshem, 1980). Uniform examination procedures and standardized measurement techniques were used throughout the study period (1990–1995). Employers who send their employees for periodic health examination at the center include some of the country's largest firms in finance, insurance, public utilities, health care, and manufacturing. Other investigators, who have systematically compared the sociodemographic characteristics of samples that they had drawn from the center's database with the general Jewish population of the country, concluded that the examinees were representative of the adult Jewish workforce (see Carl, Carmil, & Keiman, 1990; Carmil & Carl, 1986).

The respondents reported working on the average 8.8 hr per day. Male employees worked on the average 10 hr more per week than the female respondents (52 hr vs. 42 hr). By analyzing our data separately for male and female respondents, we controlled for this difference in average weekly workhours. About one third (30%) of the respondents were female. The proportion of female employees in the Jewish labor force at the time of the study was 41% (State of Israel, Bureau of Statistics, 1991). The mean ages for male and female employees were 43.3 years (SD = 8.5 years) and 40.8 years (SD = 6.5 years), respectively. About 82% of the respondents were married, and of these 80% had children (on the average, two children). The sample, when compared to the Jewish labor force, was biased in favor of employees with managerial jobs (20% vs. 5.3%) and employees holding academic degrees (27% in the sample as compared with 16% in the labor force; see State of Israel, Bureau of Statistics, 1991). The sample thus overrepresented managerial and highly educated employees, which is indicative of the fact that some employers offer periodic health examinations to their senior employees as a fringe benefit.

Procedure

The design of the study is quasi-longitudinal in that we collected data on the two criteria at two points in time, 2 or 3 years apart on the average. Respondents completed the study's Time 1 (T1) questionnaire when they came to the center to undergo the periodic health examinations in 1990–1991. While they were awaiting their turn for the clinical examination, the attending M.D. approached each respondent, requesting his or her voluntary participation in the study by completing the questionnaire, assuring the respondents orally and in writing of the total confidentiality of the data obtained from them. About 95% agreed to complete the questionnaire. At that time, they also completed a computerized questionnaire developed from the Cornell Medical Index (Broadman, Erdman, Langer, & Wolf, 1956; Haestler, Holland, & Elstain, 1974), which included sociodemographic characteristics such as those reported above. The second stage of the comprehensive health examination consisted of blood tests, a physical examination by a physician, ECG recording, and respiratory measurement of the lung function. Also assessed during this stage were the respondents' weight, height, blood pressure, pulse rate, routine urinalysis, and vision and hearing functions. The measuring of most of these physiological parameters at the center is fully automated and directly fed into the computerized data bank. We used the center's ID number of each respondent to combine the three different data sets: the study's questionnaire, the computerized Wolf questionnaire with the sociodemographic data, and the data set with the biochemical, hematological, and physiological measurements.

Time 2 (T2) measures of serum lipids were obtained from the respondents when they returned to the center to be reexamined; in most (92%) of the cases, this was either 2 or 3 years after T1 measurements, though we also included in the sample those who returned after four years (n = 52). We decided to include in the study the group of respondents who returned to the center for periodic health examinations after 2 or 3 years because this period appeared optimal for the study of the effects of social-psychological stress on psychological and physiological strain (Frese & Zapf, 1988).

In all subsequent analyses, we combined the cohorts of respondents into one group. This was done after we had ascertained that the mean vectors of the predictors were not significantly different between those who returned to the center after 2 years and those who returned after 3 years, Hotelling's $T^2 = 6.4, ns; F(10, 593) = 1.6, p > .05,$ and between those who returned after 3 years and those who returned after 4 years, Hotelling's $T^2 = 5.9, F(10, 417) = 1.3, ns.$
Research Instruments and Measures

From the computerized questionnaire, we obtained the set of control variables, including age, sex, smoking (number of cigarettes smoked per day and years of smoking), consumption of alcoholic drinks (number of glasses per week), and health habits (specifically, being on a diet). The body mass index used in the study was measured by the Quetelet ratio, comprised of the respondent’s weight (in kilograms) divided by the squared term of his or her height (in meters). These control variables have been found to affect the levels of serum lipids (Fried, 1988). We did not use tenure as a control variable because for this sample it was highly correlated with age (i.e., r > .73 for male and female respondents). Fasting blood samples were drawn from the respondents in the morning, upon arrival at the center for the health examinations. The levels of total cholesterol and triglycerides were determined using the Coulter “S” Counter, calibrated daily using the 4C Standard of Coulter Electronics. For details on the reliability of these measurements, see Carel and Lesher (1980).

The psychosocial variables in the study were all constructed on the basis of the T1 questionnaire (which was not completed at T2, due to budgetary constraints). All multi-item indexes in this questionnaire had been included in our previous research, where they had exhibited high reliabilities and construct validities. Almost all items in the study’s questionnaire were measured on 5-point Likert-type scales. Multiple-item indexes were constructed by combining single items that measured the same variable, as verified by factor analyses (the detailed results are available from the authors upon request). The respondent’s score on each of the indexes was obtained by computing the mean of his or her responses to the items in the index. Index reliability was gauged by the alpha coefficient (i.e., Cronbach’s internal consistency reliability). In the following description of each index, we include examples of the items it contains. Means and standard deviations for the indexes are presented in Table 1.

Overload (8 items, α = .88) is a measure of subjective quantitative overload. It was scored high for respondents who reported that they were required to work too fast, too hard, had too much work to do, and had insufficient time to get the required work done. This measure was used in several past studies (e.g., Shirom et al., 1981).

Workhours was the measure of objective overload, represented by the reported average number of workhours per week (1 item). Emotional burnout, referred to as burnout, was constructed to tap emotional exhaustion (5 items, α = .88). The items in this scale requested respondents to indicate how often they felt, during their work or in their job, burned out, emotionally drained, and like their batteries had run out. Physical fatigue, referred to as fatigue (3 items, α = .70), was scored high for respondents who reported often feeling tired, physically drained, and physically lethargic at work. For a summary of the procedures used to validate the two measures of burnout and fatigue, see Shirom (1989) and Melamed, Kushnir, and Shirom (1992).

Emotional reactivity was measured with the original version (11 items, α = .90) of the scale developed by Melamed (for full details on this version, see Melamed, 1994). It was designed to gauge the following characteristics: (a) tendency to experience intrusive and repetitious thoughts following emotional events, (b) inability to control emotional arousal despite conscious attempts to do so, (c) tendency to become emotionally aroused when anticipating future events, and (d) excessively long and intense emotional responses to emotional events.

Analytic Methods

In the multivariate analyses, we generally controlled for well-known confounding variables, such as age and body mass index, in a manner similar to that of French, Caplan, and van Harrison (1982, pp. 26-27). The hypotheses were tested by moderated multiple regressions (Aiken & West, 1992, pp. 9-10) run separately for the male and female respondents. In the regression on each of the criteria, total cholesterol and triglycerides, we first entered the T1 level of the respective criterion in order to make the criterion a change score from T1 to T2. In the second step, we entered the statistical control variables in order to weed out their confounding effects. In the third step, we entered the main effects of the psychological strains, in the fourth step the main effects of the two measures of overload, and finally in the fifth step the multiplicative terms specified in our hypotheses (for the statistical rationale of the sequence, see Cortina, 1993). To reduce the possibility of multicollinearity among the product terms of the interactions and their component predictors, the latter were centered (i.e., we subtracted the mean, a constant, from each of the predictors) prior to the regression runs (cf. Aiken & West, 1992, pp. 28-35; Cronbach, 1987).

Results

Table 1 presents the means, standard deviations, and intercorrelations of the study variables. We used the Chow Test (Fiduccia & Rubenfeld, 1981, pp. 123-124) to check the appropriateness of the separate regression runs for male and female respondents. The results of this test, F(10, 425) = 5.95 and F(10, 181) = 5.14, for cholesterol and triglycerides, respectively, ps < .05, supported the statistical justification for the subgroup analyses reported below in that the vectors of regression weights for the two groups were significantly different from each other for both of the criteria.

Table 1 provides a more detailed description of the same results. For each of the study’s variables, we used two-tailed t tests to check the significance of the mean differences between the male and female employees. It is evident from Table 1 that male and female employees had significantly different mean values for all of the study’s variables, though the differences were not systematically in the same direction. Male employees reported significantly higher levels of overload but significantly lower levels of burnout relative to the female employees. In agreement with the findings of other researchers (Green et al., 1992), male employees' levels of serum lipids were significantly higher than those of the
female employees for both T1 and T2. The correlations between the levels of cholesterol and triglycerides were about .37 and .43 for the male and female groups, respectively, thus supporting their analysis as distinct criteria. For the pattern of relationships among the two serum lipids and overload and burnout, there was only one significant correlation coefficient. For female employees, overload was negatively correlated with T1 level of triglycerides. Our hypotheses, however, were all formulated after controlling for possible confounders like age and obesity and, more importantly, for the T2–T1 changes in serum lipid levels. Therefore, we considered the regression runs as the direct tests of the study’s hypotheses.

The results of the tests of the study’s hypotheses are presented in Tables 2 and 3. For each hierarchical regression run, we first entered the level of the respective serum lipid in T1, to make the criterion under consideration a change score. In the second step, we entered the control variables: age, body mass index, being on a diet, smoking intensity, and alcohol consumption. The predictors entered in the third step were the three psychological strains, namely, burnout, fatigue, and emotional reactivity. In the fourth step, we entered overload and work hours. To test Hy 4 and Hy 4a, we entered, in the fifth step, the expected interactions among emotional reactivity and the two types of burnout.

Table 2 and 3 present the results for the regressions of cholesterol and triglycerides, respectively, on the predictors for female and male employees. None of the psychosocial predictors significantly predicted T2–T1 changes in the level of triglycerides for the male respondents, and this regression is therefore not reported in Table 3. Thus, results for the male respondents do not support any of the hypotheses concerning triglycerides. As evident from the two tables, the first hypothesis was supported only for the effects of overload on cholesterol level among female employees. Work hours did not emerge as a significant predictor in either regression.

The first part of the second hypothesis (Hy 2a), which had to do with the effects of burnout and fatigue on subsequent elevation of serum lipids, was only partially supported. Burnout was found to be a positive predictor of changes in the levels of cholesterol among male employees (the coefficient for female employees was not significant) and, for females only, of subsequent elevations in the level of triglycerides. Contrary to Hy 2a, we found that for

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cholesterol, T1</td>
<td>206.7</td>
<td>39.9</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2. Triglycerides, T1</td>
<td>144.3</td>
<td>67.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3. Age</td>
<td>43.5</td>
<td>8.6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4. Body mass index</td>
<td>27.9</td>
<td>4.6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5. Burnout</td>
<td>4.7</td>
<td>6.4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6. Fatigue</td>
<td>2.3</td>
<td>3.1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7. Overload</td>
<td>2.3</td>
<td>2.7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>8. Work hours</td>
<td>2.3</td>
<td>2.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>9. Cholesterol, T2</td>
<td>210.0</td>
<td>59.2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10. Triglycerides, T2</td>
<td>150.5</td>
<td>87.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>M</td>
<td>105.6</td>
<td>40.8</td>
<td>3.4</td>
<td>10.1</td>
<td>3.4</td>
<td>24.5</td>
<td>3.4</td>
<td>0.7</td>
<td>3.9</td>
<td>1.2</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>SD</td>
<td>36.8</td>
<td>17.5</td>
<td>2.2</td>
<td>1.2</td>
<td>2.2</td>
<td>4.4</td>
<td>2.2</td>
<td>0.6</td>
<td>2.5</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Note: Entries above the diagonal represent the male employees' parameters, and those below the diagonal represent the female employees' parameters. Underlined coefficients are significant at the p < .05 level. T1 = Time 1; T2 = Time 2.
female employees, fatigue was a significant negative predictor of subsequent elevations of serum lipids.

Hy 2b predicted that burnout and fatigue would partially mediate the detrimental effects of overload on the two criteria. Following the recommendations of Baron and Kenny (1986), we ran three sets of regressions to test it. We first regressed burnout and fatigue on overload. For both male and female respondents, burnout and fatigue were moderately correlated with overload. Mixed results were obtained for the correlations of workhours with burnout and fatigue. Workhours and fatigue were negatively correlated for female respondents, and workhours and burnout were positively correlated for male respondents. These results are evident from the pattern of correlations reported in Table 1.

In the second set of regressions, we tested the direct effects of overload and workhours on subsequent elevations of serum lipids among male and female employees (Baron & Kenny, 1986, p. 1177). We were

---

Table 2
Summary of Moderated Multiple Regressions of Time 2 Cholesterol on Time 1 Cholesterol, Control Variables, and Other Predictors, for Female and Male Employees

<table>
<thead>
<tr>
<th>Variable</th>
<th>Female employees</th>
<th></th>
<th></th>
<th>Male employees</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SEB</td>
<td>β</td>
<td>ΔR²</td>
<td>B</td>
<td>SEB</td>
</tr>
<tr>
<td>Step 1: Controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time 1 cholesterol</td>
<td>0.67*</td>
<td>0.06</td>
<td>.64</td>
<td>.52*</td>
<td>0.69*</td>
<td>0.03</td>
</tr>
<tr>
<td>Body mass index</td>
<td>0.39</td>
<td>0.53</td>
<td>.04</td>
<td></td>
<td>0.11</td>
<td>0.41</td>
</tr>
<tr>
<td>Age</td>
<td>1.46*</td>
<td>0.33</td>
<td>.24</td>
<td></td>
<td>0.27</td>
<td>0.16</td>
</tr>
<tr>
<td>Step 2: Main effects of strains</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emotional reactivity</td>
<td>-4.41</td>
<td>3.24</td>
<td>-.08</td>
<td>-.02*</td>
<td>-5.75*</td>
<td>2.15</td>
</tr>
<tr>
<td>Burnout</td>
<td>2.38</td>
<td>2.29</td>
<td>.07</td>
<td></td>
<td>3.25*</td>
<td>1.35</td>
</tr>
<tr>
<td>Fatigue</td>
<td>-5.51*</td>
<td>2.67</td>
<td>-.15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 3: Main effect of stress</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overload</td>
<td>6.49*</td>
<td>2.66</td>
<td>.14</td>
<td>.01*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 4: Interactions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burnout and emotional</td>
<td>-4.93*</td>
<td>2.21</td>
<td>-.12</td>
<td>.01*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Total R² = .55, .53 (adjusted), and Ns = 130 and 440 for the female and male employees' regressions, respectively. An empty cell indicates that the row predictor was not a significant predictor of the criterion. The symbols B and β represent the unstandardized and standardized partial regression coefficients, respectively, and SEB stands for the standard error of the former. The symbol ΔR² stands for the incremental squared multiple correlation coefficient, adjusted for degrees of freedom, for the respective step of the regression.

* Diet (coded as 1 = on a diet, and 0 = not on a diet), smoking intensity for smokers, and weekly alcohol consumption were included as additional control variables in earlier regressions but were found not to be significant predictors of the study's criteria. Therefore, they were omitted from the table.

*p < .05.

---

Table 3
Summary of Multiple Regression of Time 2 Triglycerides on Time 1 Triglycerides, Control Variables, and Other Predictors for Female Employees (n = 194)

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SEB</th>
<th>β</th>
<th>ΔR²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1: Controls</td>
<td></td>
<td></td>
<td></td>
<td>.32*</td>
</tr>
<tr>
<td>Time 1 triglycerides</td>
<td>0.50*</td>
<td>0.08</td>
<td>.48</td>
<td></td>
</tr>
<tr>
<td>Body mass index</td>
<td>1.34</td>
<td>0.96</td>
<td>.10</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>1.50*</td>
<td>0.53</td>
<td>.19</td>
<td></td>
</tr>
<tr>
<td>Step 2: Predictors, main effects of strains</td>
<td></td>
<td></td>
<td></td>
<td>.02*</td>
</tr>
<tr>
<td>Emotional reactivity</td>
<td>1.55</td>
<td>5.22</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td>Burnout</td>
<td>9.45*</td>
<td>3.66</td>
<td>.22</td>
<td></td>
</tr>
<tr>
<td>Fatigue</td>
<td>-9.87*</td>
<td>4.27</td>
<td>-.19</td>
<td></td>
</tr>
</tbody>
</table>

Note. Total R² = .34. The symbols B and β represent the unstandardized and standardized partial regression coefficients, respectively, and SEB stands for the standard error of the former. The symbol ΔR² stands for the incremental squared multiple correlation coefficient, adjusted for degrees of freedom, for the respective step of the regression.

*p < .05.
able to confirm only one out of eight possible direct effects that were expected. For female employees, overload was found to be negatively associated with changes in cholesterol levels ($\beta = .17, p < .01$). In the third set of regressions, we regressed, separately for male and female respondents, each measure of serum lipids on overload and workhours, controlling for the confounders. We found that this hypothesis was supported only for the prediction of T2 cholesterol among female employees ($\beta = .14$, $p < .01$). Neither overload nor workhours predicted any of the criteria for the male respondents. Therefore, we concluded that the mediational hypothesis, Hy 2b, was not supported.

The results reported in Tables 2 and 3 provide no support for the two parts of the third hypothesis. Indeed, emotional reactivity emerged as negatively associated with subsequent elevations of cholesterol for male employees, contrary to our expectation in this regard. Emotional reactivity was not a significant predictor of change in the level of triglycerides in either group of respondents.

The fourth hypothesis was supported in only one out of the eight tests for interaction effects involving emotional reactivity and either burnout or fatigue. Therefore, it was considered as not being supported. The only significant interaction found was for female employees, in the regression of T2 (adjusted for T1) cholesterol on the predictors. This significant interaction is depicted in Figure 2.

As evident from Figure 2, the interaction found was the polar opposite of our expectation (Hy 4): For low levels of emotional reactivity, those reporting higher levels of burnout experienced higher levels of T2 cholesterol adjusted for T1 cholesterol.

Discussion

This research attempted to identify linkages among certain psychosocial job characteristics and serum lipids. It followed the path of research initiated by several Dutch researchers (Appels & Schouten, 1991; van Doornen & van Blokland, 1989) who suggested that the effects of burnout on CHD risk may be mediated by means of the lipid metabolism. This group of researchers, however, defined burnout as "vital exhaustion" and included in their definition certain aspects of depression (cf. Appels, Hoppener,
& Mulder, 1987). Also, they focused on a critical event as a stressor, such as examination stress among students (e.g., van Dooren & van Blokland, 1987, 1989).

Our study involved healthy employees in Israel, focused on chronic stress, and used a construct-validated definition of burnout that did not confound it with depression or other affective states (for evidence supporting this claim, see Melamed, Kushner, & Shirom, 1992; Shirom, 1989). Specifically, we studied the effects of two types of chronic overload, objective and subjective, and of two types of burnout, physical and emotional, on cholesterol and triglycerides levels. The two criteria were measured longitudinally, thus allowing us to relate T1 levels of the psychosocial characteristics to changes over time in the levels of serum lipids. We also tested the extent to which these relationships were moderated by emotional reactivity. The study’s hypotheses were tested separately for male and female employees, because gender-specific effects were expected.

What did we find? For female employees, the T2–T1 changes in the levels of cholesterol and triglycerides tended to be positively predicted by emotional burnout, as expected, but were negatively predicted by fatigue, thus disconfirming our expectation in this regard. Subjective overload was found to predict, for female employees only, subsequent elevations in the level of cholesterol, in conformance with the results obtained by other researchers in prospective studies (e.g., Siegrist, Peter, Motz, & Strauer, 1992). In line with the findings of McCann, Warrick, and Knopp (1990), objective overload, gauged by the number of weekly workhours, did not predict any of the criteria after controlling for the effects of subjective overload. For male employees, burnout was a positive predictor of the change from T1 to T2 in cholesterol level, as we hypothesized. The expected moderating effect of emotional reactivity on the burnout–lipids relationship was found only for female employees, for the T2–T1 change in cholesterol level, thus not supporting the expected interaction effect of emotional reactivity.

For male employees, our findings concerning the predictive power of burnout on cholesterol levels corroborate earlier research implicating burnout as an independent risk factor for coronary heart disease (Appels & Schouten, 1991), and further support our earlier research (Melamed, Kushner, & Shirom, 1992), though in a quasilongitudinal design. However, for female employees, our results suggest that not all types of burnout influence lipid levels in the same direction. The implication of this finding for further research in the area of burnout is given below.

Like other researchers (Niura et al., 1992), we failed to find a significant association between triglycerides and psychosocial characteristics for male employees. This could be accounted for by the biological variability of the measurement of triglycerides, which was not fully addressed by the two measurements of this lipid in our study. It is well known that a single fasting triglycerides value may inadequately represent this lipid (NIH Consensus Conference, 1993). For female employees, burnout and fatigue were found to predict subsequent elevations of triglycerides, in opposite directions. Recent research has suggested that triglycerides may be an independent risk factor for coronary atherosclerosis among women but not among men (Kannel & Wilson, 1992). Therefore, this finding suggests that the study of burnout, as it affects the level of triglycerides, does have the potential to advance our understanding of its etiology among women.

Before discussing our results, it is appropriate to note some of the limitations of the study. First, it could be argued that the favorable changes in several cardiovascular risk factors, including serum cholesterol, experienced since the mid-1960s by many industrialized countries (Goldbrout et al., 1993; Goldman & Cook, 1984; Sparka, Burke, Folsom, Luepker, & Blackburn, 1990), including Israel (Green et al., 1992), make this study less relevant. However, if indeed stress at work exerts a negative influence on lipid concentration, thus counteracting the above trend, this could have implications for efforts to develop strategies to lower hyperlipidemia. Wardle (1995), in her review of several meta-analyses of cholesterol-lowering intervention trials, indicated that these studies suggest some unfavorable effects of the interventions on total mortality. Therefore, research effort directed at identifying environmental sources of unfavorable changes in serum lipids appears to be highly relevant.

Second, the study’s external validity should be considered. We do not have any data on the extent to which employees who were eligible for the periodic health examination declined their employer’s offer to undergo such a check-up. It is well known that preventive health behaviors like going for a health check-up vary among different categories of employees (Kirsch, 1983). In the USA, a 1992 survey reported that 32% of all workplaces offer periodic health examination to their employees (U.S. Department of Health and Human Services, Public Health Service, 1993). In Israel, this appears to be the norm.
among most large employers, but as we noted these periodic health check-ups tend to be restricted to professional and managerial employees. This may explain why the sample we studied was biased in favor of these categories of employees.

Yet another reservation that concerns the study's external validity has to do with the self-selection of employees into our sample. The sample is self-selective in that, for example, employees suffering from advanced cases of burnout were probably no longer working in the organization, leaving behind the more hardy ones to report their levels of burnout to us on coming for the periodic health examinations. This so-called healthy worker effect is further reinforced by our decision to omit from the sample all those diagnosed as suffering from chronic diseases. The healthy worker effect probably militates against our hypothesis, in that we are less likely to have highly overloaded or burned-out respondents in our sample, which leaves us with, in effect, a truncated distribution on these predictors.

Yet another major limitation of this study is the fact that we did not have T2 measures of the psychosocial characteristics and therefore had to use their T1 values as proxies of chronic overload and stage of burnout of our respondents. This use of psychological characteristics at T1 only is supported by the phrasing of the items gauging these predictors in the questionnaire; they all asked respondents to relate to the chronic aspects of burnout and overload. However, for several reasons, the levels of overload and burnout reported on the T1 questionnaire may not be representative of the respondents' chronic exposure to overload and ongoing feelings of burnout. Employees may gain more effective coping skills with age and tenure, may be job-rotated, or may select themselves out of the more overloading jobs. In support of our decision to use T1 values of burnout as proxies for the respondents' chronic levels of burnout, we may note that several longitudinal studies have reported test-retest reliabilities in the high .70s for employees in different occupations (Hobfoll & Shirom, 1993; Schaufeli, Enzmann, & Girault, 1993). Furthermore, to the extent that burnout progressively develops over time to more advanced stages, in accordance with certain developmental theories of burnout (Leiter, 1993; Shirom, 1989), our measurement probably underestimated the true level of burnout. Though having T1 data only on the predictors may have mitigated against our hypotheses, future research should replicate our findings in a full-panel design.

To conclude the list of caveats, the time lag between T1 and T2 (for most respondents it was either 2 or 3 years) appears insufficient to capture clinically significant elevations of serum lipids. On the average, cholesterol levels increased by 1.6% and 2.0%, and triglycerides levels by 4.0% and 2.3%, for male and female respondents, respectively. Therefore, the amount of change in each of the criteria to be explained by the psychosocial factors was initially small. This situation was only aggravated by our decision to adopt a conservative analytical strategy and control for all possible confounders in the regression. These control variables included age, obesity, diet, smoking, and alcohol consumption, even though it could be argued that they had already influenced the criteria's T1 levels. To counter this argument, we claim that these limitations mitigated against our hypotheses, and therefore augment our confidence in the reported findings, which were obtained under very conservative constraints. It further follows that the small effects of burnout on subsequent elevations of serum lipids, reported above, could have been expected. In stress research, small effects of stress on physiological strain are common (Frese & Zapf, 1988). We studied only one type of chronic stress, and only stress at work. Still, even the small effects that we reported, for burnout on subsequent elevations of cholesterol among males and triglycerides among females, could be very meaningful for those representing borderline cases on the critical values of the two serum lipids.

What could be the explanation for the unexpected negative effects of fatigue on both cholesterol and triglycerides levels among female employees? It is possible that women differ from men in their interpretation of physical fatigue (Jick & Mitz, 1985). We obtained this finding only after controlling for emotional burnout in the regression; therefore, it could be that women tend to interpret that portion of the variance of physical fatigue that is unrelated to emotional burnout as tiredness following active confrontation with stresses, which is in turn a coping strategy found to be negatively correlated with serum lipids (cf. Rosenman, 1993a). A major implication of this finding for future research on burnout is that it provides strong support for the predictive validity of the multidimensional conceptualization of burnout (Shirom, 1989). This multidimensional view has recently been supported by other studies of burnout's construct validity (Byrne, 1994; Schaufeli, Enzmann, & Girault, 1993).

The unexpected negative effect of emotional reactivity on changes in the level of cholesterol found for male employees runs counter to past findings (e.g., Melamed, 1994). The same is true for the
finding that emotional reactivity acted to buffer the effects of burnout on changes in cholesterol levels for female employees. To the extent that emotional reactivity taps a general level of emotional arousability, our findings are in agreement with those reported in the longitudinal study by Rahe, Rubin, Arthur, and Clark (1968) on arousal among Navy frogmen. However, as conceptualized, emotional reactivity represents inefficacy in self-control of thoughts, images, and their resultant emotions, and not emotional arousability. A possible explanation of the above finding is that for the respondents, high levels of emotional reactivity are indicative of “tension out” relative to “tension in,” that is, a tendency to exhibit outward tension and discomfort. The “tension out” proclivity was shown to lead to decreased risk of CHD morbidity and mortality (Graves et al., 1994), and therefore could be regarded as possibly associated with a favorable lipid profile. It may also be that emotionally reactive respondents tend to be self-focused. Self-monitoring has been associated with self-care or engaging in health habits (Kirsch, 1983), behaviors that may exert a favorable impact on the respondents’ lipid profile.

In sum, the major strengths of this study had to do with the multitrait measures of stress (i.e., objective and subjective overload) and strain (i.e., burnout and fatigue) and the quasilongitudinal nature of the measurement of serum lipids. The fact that our criteria were change scores from T1 to T2 eliminated many of the problems associated with the measurement of serum lipoids, as noted by Fried (1988). Thus, the evidence presented in this study suggests that stress may impact serum lipoids by means of burnout and, further, that burnout is directly implicated in elevations of cholesterol, and, for female employees, also of triglycerides. Further delineation of the mechanisms that mediate the effects of burnout on subsequent elevations of serum lipoids may have direct relevance to increasing our understanding of the pathogenesis of cardiovascular disease.

References


Received September 8, 1995
Revision received March 7, 1996
Accepted May 15, 1996
