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Health a

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## Burnout and Vigor as Predictors of the Incidence of Hyperlipidemia among Healthy Employees

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We examined the effects of burnout and vigor on the incidence of hyperlipidemia. Based on the bivariate theoretical approach to negative and positive affects and on past studies on the prediction of blood lipids by burnout and vigor, we expected increases from Time 1 (T1) to Time 2 (T2) in burnout levels to be associated with an increase in the risk for hyperlipidemia and T1–T2 increases in vigor levels to be associated with a decrease in the risk of hyperlipidemia. Our sample consisted of 3,337 healthy employees (2,214 men and 1,123 women) who were followed up for about 27 months on average. Burnout and vigor were assessed by well-validated multiple-item instruments. We used logistic regressions and controlled for variables associated with blood lipids as well as with vigor and burnout. We cross-validated all self-reported hyperlipidemia by their T2 lipids levels. As expected, we found that T1–T2 increases in vigor levels were associated with a decreased risk of hyperlipidemia. However, the T1-T2 change in burnout levels was marginally significant (p = .06) in predicting hyperlipidemia. We consider our finding that vigor and burnout are independently associated with the risk of hyperlipidemia as providing support for the bivariate approach to affective states. In addition, our major finding suggests a possible mechanism via which vigor influences physical health outcomes.

Keywords: blood lipids, burnout, hyperlipidemia, vigor

## INTRODUCTION

The current study focuses on the effects of job-related burnout and vigor on the incidence of hyperlipidemia among healthy employees followed up for

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about 27 months. We focused on hyperlipidemia because it is one of the major causes of atherosclerosis, a precursor of coronary heart disease (Bertolotti, Maurantonio, Gabbi, Anzivino, & Carulli, 2005; Bhatnagar, Soran, & Durrington, 2008). Hyperlipidemia, characterised by abnormal alterations in the profile of plasma lipoprotein including high triglyceride levels, low high-density and high low-density lipoprotein cholesterol, is now routinely treated primarily by medicines such as the family of statins representing the best-selling drug world-wide—prescribed by family physicians (Shojania et al., 2010). Lipid-modifying therapy, whose targets have become increasingly aggressive, has been proven to significantly reduce cardiovascular events and total mortality for individuals who are at higher than average risk of cardiovascular disease (Glassberg & Rader, 2008) and therefore continues to be widely applied for those diagnosed to have hyperlipidemia (Crawford et al., 2010).

There were several reasons for our focus on the predictive power of burnout and vigor with respect to hyperlipidemia. Both constructs have been found to predict physical health outcomes (Ahola, Vaananen, Koskinen, Kouvonen, & Shirom, 2010; Melamed, Shirom, Toker, Berliner, & Shapira, 2006; Shirom, 2011; Shirom, Toker, Jacobson, & Balicer, 2010a; Shirom, Toker, Melamed, Berliner, & Shapira, 2010b). However, the mechanisms underlying the effects of burnout and vigor on physical health remain unclear, and the possible mediating role of blood lipids has hardly been investigated.

# Burnout and Vigor: The Bipolar versus Bivariate Theoretical Approaches

By affect, we refer to the phenomenological experience of feeling; state affect, the focus of this study, covers both moods and emotions (Watson, 2000). We regard burnout as a negative affect and vigor as a positive affect (Shirom, 2011). Burnout is conceptualised to represent physical, emotional, and cognitive exhaustion (see Melamed et al., 2006). Vigor is conceptualised to represent one's feeling energetic physically, emotionally, and cognitively (see Shirom, 2011; Shraga & Shirom, 2009). We argue that burnout and vigor are two distinct dimensions of employees' work-related affective experiences, and therefore expect each to independently predict the incidence of hyper-lipidemia. An alternative theoretical position (e.g. Maslach & Leiter, 2008) views burnout and vigor as representing two poles on the same dimensional continuum, each providing a mirror-image of the other. These opposite theoretical views, explained below, have rarely been juxtaposed in reference to a physical health outcome such as hyperlipidemia.

We refer to the alternative theoretical approach as the bipolar approach because it posits that vigor and burnout represent two polar opposites on the

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same affective continuum and therefore cannot be experienced simultaneously (Maslach & Leiter, 2008). The major argument in favor of the bipolar approach emphasises the semantics of affects in different languages which express opposite affects (Feldman Barrett & Russell, 1998). This argument focuses on momentarily felt emotions, proposing that it is highly unlikely that a person can feel both sad and happy at the same time. Some researchers (e.g. Maslach & Leiter, 2008) have applied this argument to affects experienced over days or weeks, as burnout and vigor are conceptualised in the current study. Often, researchers apply the bipolar approach by reverse-scoring burnout items to construct a measure of vigor as the antipode of burnout (e.g. Maslach & Leiter, 2008).

The theoretical position adopted in the current study and referred to as the bivariate approach, argues that vigor and burnout, when not assessed momentarily but over some time, are obliquely related. The bivariate approach is well supported by past research on vigor and burnout (for a list of references, see Shirom, 2011) and on positive and negative affects in general (Larsen & McGraw, 2011). Therefore, we expect each to have a distinct and independent influence on health outcomes such as hyperlipidemia. We base our position on the following arguments. First, positive and negative affects, such as vigor and burnout, represent the affective components of two biobehavioral systems that underlie approach (the facilitation system) and withdrawal (the inhibition system) behaviors (see Watson, Wiese, Vaidva, & Tellegen, 1999). These biological systems have been shown to be basically independent (Cacioppo, Berntson, & Gardner, 1999). Second, positive and negative affective states are physiologically represented in different systems and involve the activation of different sites in the brain. For instance, when people are experiencing a negative affective state, the most active sites in the brain are circuitry converging on the amygdale (part of the brain's emotional center) and the right prefrontal cortex (a brain region that controls the hyper vigilance typically found among people under stress). By contrast, among people who experience positive affective states, the left prefrontal cortex is highly activated, whereas the prefrontal cortex remains quiet (Davidson, 2000). Third, positive and negative affective states have been shown to have different antecedents (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001); they may function relatively independently (Davis, Zautra, & Smith, 2004), and they are differentially represented in people's behaviors (Gendolla, 2000). Last, a recent study has shown that positive and negative affective states may co-occur and are separable in experience (Larsen & McGraw, 2011).

We were unable to identify any prior study which tested if vigor and burnout relationships with health-relevant outcomes follow either the bivariate or the bipolar approaches. We argue that the current study fairly compares the predictive validities of vigor and burnout because they are defined

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as representing feeling energetic and feeling depleted of energy, respectively, are similarly contextualised as two affective states at work, and—following a recent review (Reich, Zautra, & Davis, 2003)—are assessed based on the same time frame.

## **Conceptualising Vigor and Burnout**

Following past research (e.g. Halbesleben, 2006; Shirom, Toker, Berliner, Shapira, & Melamed, 2008), we conceptualised both vigor and burnout based on the Conservation of Resources theory (COR; Hobfoll, 1989; Hobfoll, 2002). For several theoretical reasons and following COR, we focused on three types of personal resources: physical, emotional, and cognitive resources. First, COR theory argues that these resources represent a set of resources internal to the self (Hobfoll, 2002; Hobfoll & Shirom, 2000). Second, physical, emotional, and cognitive energy are individually possessed, and are expected to be closely interrelated (Hobfoll & Shirom, 2000). Third, these resources facilitate the development and use of other resources (Hobfoll, 2002). Fourth, COR theory postulates that these personal resources affect one another and exist as a resource pool—lacking one is often associated with lacking another; conversely, having one is often associated with having another (Hobfoll, 1989, 2002).

*Burnout* is viewed as a psychological strain representing a process of depleting personal coping resources (Halbesleben, 2006; Melamed et al., 2006). It is a construct whose three facets are physical fatigue (feelings of tiredness and low energy), emotional exhaustion (lacking the energy to display empathy to others), and cognitive weariness (feelings of reduced mental agility). Other conceptualisations of burnout have been suggested (see Halbesleben, 2006). The most frequently used alternative conceptualisation of burnout, gauged by the Maslach Burnout Inventory (MBI; Maslach, Jackson, & Leiter, 1996), views it as a syndrome consisting of emotional exhaustion, depersonalisation, and reduced perceptions of personal accomplishment. The MBI has been found (Shirom & Melamed, 2006) to be comparable in terms of construct validity to the above conceptualisation of burnout.

*Vigor* represents an affective state which comprises individuals' feelings of possessing physical strength, emotional energy, and cognitive liveliness (for a qualitative study supporting this conceptualisation, see Shraga & Shirom, 2009). There is evidence supporting the position that vigor represents a unique type of affect—distinct from affects whose core content represent calm energy such as pleasantness (Russell & Steiger, 1982). The individual level of vigor is often considered as an indicator of a person's optimal psychological functioning. Most people want to feel energetic and view it as a significant dimension of their affective experiences (Shraga & Shirom, 2009). For example, it has been found that one of the main reasons people engage in

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physical activity is to experience vigor (Hansen, Stevens, & Coast, 2001; Reed & Ones, 2006). There are alternative conceptualisations of vigor, such as energetic arousal (Thayer, 1989) or positive affective arousal (Watson & Tellegen, 1985) or the Vigor/Activity subscale of the Profile of Mood States (McNair, Lorr, & Droppleman, 1971; Terry, Lane, Lane, & Keohane, 1999); they all view vigor as an important dimension of people's affective experiences (e.g. Daniels, 2000).

## The Relationships among Vigor, Burnout, and Hyperlipidemia

Burnout represents a risk for several physical health outcomes, including cardiovascular disease (CVD; Melamed et al., 2006). Vigor's linkages with physical health have barely been investigated. Two theoretical frameworks provide support to the argument that feeling vigorous will influence the incidence of hyperlipidemia. Hobfoll's Conservation of Resources theory (Hobfoll, 2002) views positive affects in general as resources that support stress resistance and may lead to a positive spiral of resource gain, thus favorably impacting individuals' physical health. Analogously, Fredrickson's Broaden-and-Build theory of positive emotions (Fredrickson & Losada, 2005) asserts that people's daily experiences of positive affects compound over time to build a variety of consequential personal resources; most of these resources are likely to positive affects impact physical health are currently not well known (Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002).

A possible physiological pathway linking vigor and burnout with blood lipids and hyperlipidemia probably involves the mediation of the hypothalamic-pituitary-adrenal axis (HPA). Various conditions such as chronic fatigue syndrome, post-traumatic stress disorder (PTSD), depression and burnout are associated with impaired HPA function (Bauer, Wieck, Lopes, Teixera, & Grassi-Olivira, 2010; Melamed et al., 2006). Burnout was found to be associated with deregulation of the HPA axis resulting in both hyper- and hypocortisolism, as well as flattened diurnal cortisol curve (Melamed et al., 2006). There is evidence to suggest that hypocortisolism, which often characterises burnout, is associated with hyperlipidemia, as manifested e.g. in persons with Addison's disease (Giordano et al., 2009). Further evidence suggests that hypocortisolism is associated with low-grade inflammation (Bauer et al., 2010). Thus, another possible physiological process through which burnout and vigor may influence the incidence of hyperlipidemia is via the process of micro-inflammation, which is related to blood lipids (Libby, Ridker, & Maseri, 2002), often assessed by the micro-inflammation biomarkers of high-density C-reactive protein (hsCRP) and fibrinogen. There is some evidence linking burnout with the process of micro-inflammation

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(Kudielka, Bellingrath, & Von Kanel, 2008; von Kanel, Bellingrath, & Kudielka, 2008). More specifically, in a cross-sectional study, burnout was found to be positively associated with fibrinogen and hsCRP in women (Toker, Shirom, Shapira, Berliner, & Melamed, 2005). In a longitudinal study, vigor was found to be negatively associated with hsCRP and fibrinogen although some of these linkages were non-linear in shape (Shirom et al., 2010b). Accumulated evidence indicates that hsCRP is moderately correlated with high-density lipoprotein cholesterol (HDL-C) and triglycerides but not with low-density lipoprotein cholesterol (LDL-C) (Ridker & Rifai, 2006, pp. 17, 326).

We could not find any prior study investigating the linkages among burnout and vigor and the incidence of hyperlipidemia, and even studies relating the two affective states to lipids' levels are very rare in the literature. In a study of healthy employees (Shirom, Westman, Shamai, & Carel, 1997), burnout in men was found to be predictive of cholesterol changes, evidenced two to three years later. A measure of burnout called vital exhaustion (VE) was found to be positively associated with atherogenic lipid profile in one study (Koertge, Ahnve, Schenck-Gustafsson, Orth-Gomer, & Wamala, 2003). As is evident from qualitative (Pressman & Cohen, 2005) and quantitative (Chida & Steptoe, 2008) reviews of positive affect and physical health, most past studies on these associations have used global measures of positive affects such as the Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988). Still, a recent meta-analytic study has provided evidence that vigor, among other types of positive affects, is prospectively linked with reduced likelihood of mortality (Chida & Steptoe, 2008); a recent study that focused on vigor provided support to this prospective linkage (Shirom et al., 2010a). Vigor may influence physical health by encouraging exercising to enhance physical fitness. Recent reviews have found vigor and physical activity to be closely interrelated, predicting each other over time (Puetz, 2006; Puetz, O'Connor, & Dishman, 2006), and there is a body of evidence (Fletcher et al., 2005) that shows that even low-intensity physical exercise lowers atherogenic blood lipids.

We adopted a longitudinal design in our study, testing changes in the levels of burnout and vigor over time as they influence the incidence of hyperlipidemia. We adopted this design because burnout was found to be influenced by variables not included in our study such as genetic factors (Middeldorp, Stubbe, Cath, & Boomsma, 2005) and personality predispositions (Alarcon, Eschleman, & Bowling, 2009); and the same is possibly true also of vigor. We assumed that the baseline levels of burnout and vigor were already influenced by antecedent variables such as genetic factors and personality predispositions. In addition, to enable us to juxtapose the predictions of the bivariate and bipolar theoretical approach, we predicted the incidence of hyperlipidemia by vigor independently of burnout and by burnout independently of vigor. Several studies found that the effects of positive affects on physiological

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variables became evident after controlling for coexisting negative affects (Chida & Steptoe, 2008). Following the above theoretical rationale and empirical evidence, our major hypothesis was that after controlling for covariates that may influence the incidence of hyperlipidemia, increases in baseline burnout levels will be associated with higher risk of hyperlipidemia during follow-up, while increases in baseline vigor levels will be associated with lower risk of hyperlipidemia during follow-up.

#### METHODS

## **Study Participants**

Study participants (N = 5,888; 3,927 men and 1,961 women) were all attending the Center for Periodic Health Examinations at the Tel Aviv Sourasky Medical Center for two routine health examination (T1, T2) between January 2003 and January 2010. As these periodic health examinations were provided to the study participants by their employers as a subsidised fringe benefit, attrition between T1 and T2 could be due to change of employer, residence, or work location, and therefore totally unrelated to their participation in the current study. At T1, they represented 92 per cent of the Center's examinees during this period, all voluntary participants of the study. Non-participants did not differ from participants on any of the socio-demographic or biomedical variables. We also tested for attrition bias from T1 to T2. As compared with the study's participants, those examined at T1 who did not return for a follow-up examination after about two years (59%) were more likely to be males, near retirement age, to have self-reported a chronic disease at T1, and to have reported spending less time in habitual exercise activity at T1. We controlled for these possible sources of attrition bias in our data analyses.

We excluded respondents who self-reported having been diagnosed with a CVD (including stroke), diabetes, or cancer at either T1 or T2, and also those who reported taking medication to treat any of these chronic diseases. Because our criterion was the incidence of hyperlipidemia at T2, we also excluded participants reporting at T1 having been diagnosed as having hyperlipidemia or regularly taking statins, fibrates, or any other lipid-lowering drug (N = 1,625; 1,130 men and 495 women). We further excluded a few respondents who were not actively employed (mostly retirees) at either Time 1 or Time 2 (N = 199; 134 men and 65 females), because burnout and vigor were being assessed at work. A further 727 participants, 449 men and 278 women, were excluded from the analysis because of missing data for one of the study parameters. Thus, the final sample consisted of 3,337 employees (2,214 men and 1,123 women). On average, respondents were about 47 years old ( $SD \sim 9$  years), with about 16 years of formal education. The T2 wave occurred on average 27 months after T1.

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## Procedure

The study's protocol was approved by the ethics committee of the Sourasky Medical Center. Each participant was recruited individually by an interviewer, received an explanation regarding the purpose of the survey, and was asked for her or his voluntary participation. Confidentiality was assured, and each participant signed a written informed consent form. As part of the periodic health examination at the Sourasky Medical Center, each respondent provided his or her medical history, underwent blood sampling after an overnight fast, a physical examination by a physician, urinalysis, stress ECG, spirometry, and vision and hearing function tests. For each respondent, the results of these examinations and his or her responses to the study questionnaire were recorded and computerised.

## Measures

Descriptive statistics pertaining to the study's variables, separately for the healthy and hyperlipidemic respondents, are presented in Table 1. The questionnaire covered background, occupational, psychological, and physical morbidity variables. *Hyperlipidemia* was defined based on the respondents self-reporting that a physician told them that they had hyperlipidemia. If answered in the affirmative, respondents were asked if they were taking statins, fibrates, or any other medicine for treating their hyperlipidemia. Using medical records as the criterion, past research found that self-reported hyperlipidemia constitutes a valid measure (Bergmann, Jacobs, Hoffmann, & Boeing, 2004; Colditz et al., 1986; Wada et al., 2009).

For the burnout and vigor measures, the respondent's score was obtained by computing the mean of his or her responses to the items in the index. Vigor at work was assessed using the Shirom-Melamed Vigor Measure (SMVM; T1 and T2  $\alpha = .87$ , .90, respectively), which includes a five-item subscale of physical strength, a four-item subscale of emotional energy, and a four-item subscale of cognitive liveliness. Respondents were requested to indicate the frequency of experiencing each of the feeling states described during the last 30 workdays, all items being scored on a 7-point frequency scale, ranging from 1-almost never, to 7-almost always. Details concerning the format and validation studies that led to the construction of the vigor measure are available elsewhere (Shirom et al., 2008; Shirom et al., 2010b; Shraga & Shirom, 2009). Job Burnout was assessed using the 14-item scale of the Shirom-Melamed Burnout Measure-abbreviated as the SMBM-which has been validated in several studies (Shirom & Melamed, 2006; Vinokur, Pierce, & Lewandowski-Romps, 2009). The SMBM (T1 and T2  $\alpha$  = .92, .91, respectively) includes three subscales: physical fatigue (six items), emotional exhaustion (four items), and cognitive weariness (four items). Examples of

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items used for assessing physical fatigue are: "I feel tired; I feel physically fatigued; I feel exhausted"; for assessing emotional exhaustion: "I feel like my emotional batteries are dead"; "I feel emotionally burned out in my job"; "I feel emotionally fatigued"; and for assessing cognitive weariness: "I have difficulty concentrating"; "my thinking process is slow". Respondents completing the SMBM were asked to rate the frequency of each feeling while at work during the past month. All items were scored on a 7-point frequency scale, ranging from "1 = almost never" to "7 = almost always".

## **Control Variables**

Variables that have been demonstrated to be associated with lipid outcomes as well as with burnout and vigor were included in our models to evaluate and, as necessary, to control for confounding. Control variables used in our analyses included age, gender, obesity, smoking, alcohol consumption, and physical exercise; all of which have been found to be associated with blood lipids levels (Stoney, Bausserman, Niaura, Marcus, & Flynn, 1999). Smoking index, for cigarette smokers only, reflected the number of cigarettes smoked on a daily basis. Physical exercises index was constructed based on a selfreported number of weekly hours habitually spent in intensive sports activities that caused pulse acceleration and sweating. Body mass index (BMI)  $(kg/m^2)$  was measured by a nurse and used as a continuous variable. Age and Gender were given by the subject in the questionnaire. As noted by a review of the area (Steptoe & Marmot, 2002), lipid profiles tend to be unfavorable in the low socioeconomic groups for both men and women, with increased LDL-C and decreased HDL-C in lower status groups. Following this body of evidence, we used a measure of financial strain as a control variable because it represents a major aspect of socioeconomic status. Financial strain was assessed by a six-item measure developed by Pearlin et al. (Pearlin, Lieberman, Menaghan, & Mullan, 1981) and often used in the literature. The six items asked respondents to report how often during the past month they had engaged in activities reflecting financial difficulties, like borrowing money to pay bills. Anchors ranged from 5 = "to a very large extent" to 1 = "not at all". Because higher levels of fruit and vegetable consumption have been associated with higher levels of HDL-C and lower levels of LDL-C (McNaughton, Mishra, & Brunner, 2009), we controlled for the number of servings of fruit and vegetables consumed on a daily basis. We also controlled for the T1-T2 lag time (assessed in days).

All lipids, used in the current study for the purpose of cross-validating self-reported hyperlipidemia, were assessed following a 12-hour fast. Total cholesterol was determined enzymatically (cholesterol esterase followed by cholesterol oxidase) on Bayer Advia 1650; CV% according to the manufacturer is 1.4%. Triglycerides were determined by the Fossati three-step

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enzymatic reaction on Bayer Advia 1650; CV% according to the manufacturer is 1.6%. HDL-C was determined directly by a method developed by Izawa, Okada, Matsui, Hotta, and Hama (1997) on Bayer Advia 1650; CV% according to the manufacturer is 1.0%. LDL-C was calculated based on the levels of total cholesterol, HDL-C, and the triglycerides.

## Analyses

All predictors were systematically examined to detect outliers or non-normal distributions (i.e. skewness > 2.0 and kurtosis > 5.0); none was detected. The control variables of age, BMI, smoking index, physical exercise index, and financial strain were based on their T1 values. For each respondent, we also calculated and controlled for the precise T1–T2 time lag in days.

In the hierarchical logistic regression predicting T2 hyperlipidemia, we first entered the control variables, followed by a second step where the T2 and T1 values of vigor and burnout were entered. Therefore, T2 levels of vigor and burnout represented the T2–T1 change in each of the predictor (Twisk, 2003). In a separate logistic regression, we tested in an explorative analysis the possibility that vigor and burnout are related to the incidence of hyperlipidemia in a non-linear or interactive manner by using the simple, quadratic, and interactive terms of vigor and burnout (Cortina, 1993). No non-linear or interactive effects were found; the detailed results are available from the second author upon request.

## RESULTS

## Validating Hyperlipidemia

We first tested the validity of the self-reported hyperlipidemia by comparing the T2 levels of LDL-C, HDL-C, and triglycerides of the hyperlipidemic respondents who did not report taking lipid-lowering drugs with those of the healthy respondents. We conducted this analysis separately for men and women because of the well-known gender differences in the levels of blood lipids (see Ingelsson et al., 2007). For the men, the mean levels of LDL-C, HDL-C, and triglycerides were significantly different for the healthy (n = 2,387) and the hyperlipidemic (n = 122) subgroups, 120.0 vs. 138.5, 50.6 vs. 47.8, and 112.4 vs. 155.5, respectively. In a similar vein, for the women, the mean levels of LDL-C, HDL-C, and triglycerides were significantly different for the healthy (n = 1,212) and the hyperlipidemic (n = 72) subgroups, 114.0 vs. 146.9, 64.0 vs. 61.3, and 91.8 vs. 124.5, respectively. For both genders, the multivariate tests that we conducted indicated that the two subgroups were significantly (p < .05) different across the means of the three blood lipids: Hotelling's Trace = .046, .090, and Wilks' Lambda = .956, 918, respectively. Consequently, we considered the self-reported diagnosis of hyperlipidemia for

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those not taking lipid-lowering drugs as being validated by their mean levels of the three blood lipids as compared with those of the healthy respondents.

## **Descriptive Statistics**

In Table 1, we present the means and standard deviations of the study variables for the T2 hyperlipidemic (n = 326) and healthy respondents (n = 3,011). The hyperlipidemic respondents had significantly higher levels of burnout and lower levels of vigor than the healthy respondents but only at T2. Also, the hyperlipidemic respondents were significantly older and more obese but smoked less than the healthy respondents. We found that the mean vectors of the two groups as displayed in Table 1 were significantly different from each other (Hotelling's Trace = .052 and Wilks' Lambda = .951, p < .001). Table 2 presents the correlations among the study variables. Hyperlipidemia, defined as a dichotomy (1 = ves, 0 = no), was not significantly associated with T1 and T2 vigor and burnout when using Pearson correlation coefficients-wellknown to underestimate an association between a binary and a continuous variable. However, our hypothesis was formulated following the adjustment of T2 values of vigor and burnout by their corresponding T1 values and following statistical control for possible confounders. At both T1 and T2, vigor and burnout were moderately correlated.

In Table 3, we present the results of the logistic regression in which T2 hyperlipidemia was regressed on T2 and T2 vigor and burnout and on the

	Healthy respondents		Hyperlipidemic respondents		
Variable	Mean	SD	Mean	SD	p-value
Burnout, T2	1.99	.81	2.11	.86	.001
Burnout, T1	2.10	.80	2.17	.85	.08
Vigor, T2	5.70	.87	5.61	.89	.05
Vigor, T1	5.54	.89	5.55	.85	.86
Gender	.34	.47	.34	.47	.95
Age	43.80	9.33	48.95	8.00	.001
Financial Stress	1.56	.64	1.56	.64	.97
Education	15.66	2.71	15.65	2.80	.95
Body Mass Index	25.97	3.89	27.31	3.95	.001
Smoking Index	.62	.48	.52	.50	.001
Physical Exercise Index	2.15	1.96	1.99	1.88	.15
Time Lag, T1–T2 (in days)	811.62	418.80	901.03	458.35	.001

TABLE 1 Means and Standard Deviations of the Study's Variables for the Hyperlipidemic and Healthy Respondents

*Note:*  $N_s$  for the healthy and hyperlipidimic respondents were 3,011 and 326, respectively, based on list-wise deletion of missing cases. T2 = Time 2; T1 = Time 1.

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		Int	ercorrela	TAE tions of	SLE 2 the Stuc	ły's Varia	ables					
Measures	Ι	2	ŝ	4	5	9	7	×	6	01	11	12
1. Hyperlipidemia												
2. Burnout, T2	.02											
3. Burnout, T1	.01	*69.										
4. Vigor, T2	03	65*	51*									
5. Vigor, T1	01	47*	58*	.66*								
6. Gender	01	.19*	.17*	09*	08*							
7. Age	.17*	10*	09*	.15*	.16*	.03						
8. Financial Strain	01	.19*	.20*	14*	14*	.13*	06*					
9. Education	.01	04*	04*	.02	.03	07*	.05*	16*				
10. Body Mass Index	$.10^{*}$	06*	05*	.06*	.08*	18*	.22*	.05*	01			
11. Smoking Index	06*	05*	05*	.02	.02	01	.13*	07*	.10*	07*		
12. Physical Exercise Index	02	12*	10*	.13*	.11*	12*	.07*	10*	.04	04*	01	
13. Time Lag, T1-T2 (in days)	.05*	.01	.02	01	05*	.07*	20*	.14*	07*	04*	.01	06*
<i>Note:</i> N = 3,337. T1 = Time 1, T2 = T	ime 2. Hype	erlipidemia	was represe	nted as a d	ichotomy, v	vith 1 = yes	and $0 = no$	* <i>p</i> < .05.				

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	В	SEB	Odds ratio	Wald test
Step 1: Control variables				
Gender (men = $0$ , women = $1$ )	.03	.13	1.03	.07
Age	.07	.01	1.07	99.41*
Financial Strain	13	.10	.88	1.91
Education	.02	.02	1.01	.13
BMI	.06	.01	1.06	19.50*
Smoking Index	25	.11	.78	4.77*
Physical Exercise Index	05	.03	.99	1.42
Time Lag, T1–T2 (in days)	.01	.001	1.01	35.79*
Step 2: Predictors				
Burnout, T2	.19	.10	1.22	3.52**
Vigor, T2	20	.09	.82	4.21*
Burnout, T1	.04	.10	1.04	0.16
Vigor, T1	.16	.10	1.18	1.18

TABLE 3 Summary of Logistic Regression Analysis Predicting the Incidence of Hyperlipidemia at T2

*Note:*  $N_{\rm S} = 3,024$  and 332 apparently healthy and hyperlipidemic respondents, respectively. The symbols B and SEB represent the unstandardised partial regression coefficient and its standard error, respectively. T2 = Time 2; T1 = Time 1; BMI = Body Mass Index. \* p < .05; \*\* p = .06.

control variables. There was strong support for our expectation that elevated levels of T2 vigor (controlling for T1 vigor) would be associated with lower incidence of T2 hyperlipidemia. However, the second part of our hypothesis, expecting elevated T2 burnout levels (controlling for T1 burnout) to be associated with a higher incidence of T2 hyperlipidemia received only marginal support (p = .06). Still, as is evident from Table 3, there was considerable support for the bivariate approach to affective states in that changes in the levels of vigor and burnout were independently related to the incidence of hyperlipidemia.

Like other positive affects, vigor probably represents a psychological resource that could moderate the effects of negative affects such as burnout on individuals' health (Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008). As explained above, in our explorative analysis we failed to support any such moderating effect. The moderate correlation between burnout and vigor at both T1 and T2, as is evident from Table 2, may cause statistical overadjustment (Christenfeld, Sloan, Carroll, & Greenland, 2004) when we controlled for vigor in our regression analysis. Therefore, we tested in separate logistic regressions the prediction of the incidence of hyperlipidemia by either T1 and T2 vigor or T1 and T2 burnout. The results indicate that T2 vigor significantly predicted a lower risk of hyperlipidemia, with odds ratio = .74 (p < .001); T1 vigor was not a significant predictor. For burnout, we found that T2 burnout was a significant predictor of the same outcome, with odds

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ratio = 1.29 (p < .005); T1 burnout was not a significant predictor. These results are very similar to those reported in Table 3, and therefore we concluded that it is highly unlikely that Table 3 reflects statistical over-adjustment.

### DISCUSSION

Our research addressed an important gap in the literature by examining the differential associations of vigor and burnout with major risk factors for coronary heart disease, the incidence of hyperlipidemia. We found that vigor and burnout—albeit with only marginal statistical significance—predict the incidence of hyperlipidemia relatively independently of each other, as we expected based on the bipolar approach to affective states. Our major finding, that increases in the levels of vigor are associated with a reduced risk of hyperlipidemia, suggests a possible mechanism explaining why feeling vigorous tends to be associated with an improved physical health status (see Shirom et al., 2008). Our results are consistent with those reported by Ryff and her associates (Ryff et al., 2006) who found that while several facets of well-being were positively associated with HDL-C and negatively associated with total cholesterol, none of the ill-being facets was significantly associated with either measure of blood lipids. Our results are also consistent with those reported by Pettit and his colleagues (Pettit, Kline, Gencoz, Gencoz, & Joiner, 2001) who found that positive affectivity predicted changes in health symptoms while negative affectivity failed to do so.

As we indicated above, vigor is a key component in several heavily used measures of affects such as the POMS and is also a key facet of measures of well-being (see Shirom, 2004). The distinctiveness of vigor and burnout in their associations with hyperlipidemia is of theoretical importance for understanding the nature of affective experiences at work and their possible impact on employee health. From a practical standpoint, it is too early to suggest that interventions designed to increase vigor may end up influencing people's risk of hyperlipidemia because our study did not identify the mechanisms that may account for this linkage. We recommend that future research explore possible mechanisms not included in our study such as eating behavior, additional positive and negative affects, and physiological mediators.

The current study has several strengths. First, it is based on a large and heterogeneous sample. Second, we carefully excluded individuals who self-reported being chronically ill or taking medication that could influence their serum lipid levels. Very few past studies have applied these strict exclusion criteria. Third, controlling for the T1 levels of our major predictors, vigor and burnout, reduced the likelihood that our findings are due to the effects of antecedents such as genetic factors and personality traits that already influenced the T1 levels of our major predictors. Future research may submit this argument to an empirical test.

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The results of this study should be interpreted with caution because of some limitations. First, our sample of participants voluntarily undergoing a periodic health examination may not be representative of the general population. They may be healthier than the general population due to the "Healthy Volunteer Effect" (Froom, Melamed, Kristal-Boneh, Benbassat, & Ribak, 1999). Most of the individuals were highly educated white-collar workers who exhibited generally good health behavior patterns: they smoked little and exercised regularly. Owing to their superior health habits, our participants may have been more resilient to the effects of burnout on hyperlipidemia. However, it is even more likely that our findings will be replicated among less resilient respondents. Second, we cannot claim that changes in the levels of vigor and burnout preceded the incidence of hyperlipidemia, because these changes and the incidence of self-reported hyperlipidemia could co-occur during the period of follow-up. Third, we based the definition of our criterion, hyperlipidemia, on the respondents' self-reports because-as reported above—we found considerable support for its validity for those not taking lipid-lowering drugs. Several different cutoff values of lipids were recommended in the literature to define hyperlipidemia or dyslipidemia (see Rizzo, Rizvi, Rini, & Berneis, 2009); in this study's context, they all ignore the possibility that the respondents' T2 levels of blood lipids were affected by taking lipid-lowering drugs.

As indicated above, positive affects may affect physical health through a variety of pathways, including central nervous system, immune, endocrine, and cardiovascular systems (Pressman & Cohen, 2005). Future research may explore the possibility that vigor predicts the incidence of hyperlipidemia via employees' coping behavior; vigor, representing a coping resource, may enable employees to cope better with work-related stressors shown to have the potential to influence blood lipids (Stoney, Niaura, Bausserman, & Matacin, 1999).

In sum, we found that changes in the levels of vigor and burnout over time differentially and independently predicted the incidence of hyperlipidemia. As expected, T2–T1 elevations in vigor and burnout were found to be negatively and positively associated, respectively, with the risk of hyperlipidemia, but the T2–T1 change in the levels of burnout was only marginally significant in predicting our health outcome. Our findings suggest that vigor and burnout represent distinct affective experiences and therefore need to be considered in future research as representing two relatively independent affective domains.

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