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The Relationship Between Job Enrichment and Abdominal Obesity: A Longitudinal Field Study of Apparently Healthy Individuals

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Obesity has become an epidemic in modern society. However, there is a paucity of research about how job context affects obesity. To enhance our knowledge we used a large, heterogeneous sample of apparently healthy employees (n = 1,949) across two time periods with an average of close to 3.5 years between measures. We tested a hypothesized curvilinear effect of job enrichment on changes in two stress related indicators of abdominal obesity over time: waist circumference (WC) and waist-hip ratio (WHR). Job enrichment consisted of the job dimensions of variety, identity, significance, autonomy, and feedback, and in our analysis we controlled for demographics and health related behaviors, including weekly sports activity, number of cigarettes smoked per day, and weekly alcohol consumption. The results supported the hypothesized U-shaped relationship between job enrichment and changes in both indicators of abdominal obesity over time, such that the level of abdominal obesity was reduced when job enrichment was moderate and was increased when job enrichment was either high or low. As expected, no such association was observed for the general obesity measure of body mass index (BMI). We discuss the theoretical and practical implications of these results.

Keywords: abdominal obesity, job enrichment, job characteristics, job stress

Obesity has become an epidemic in modern society. Moreover, the societal problem of obesity as a function of stress in the modern world and its effect on behaviors (e.g., risk of involvement in work accidents) and a variety of health impairment indicators that threaten modern societies (e.g., diabetes, blood pressure, heart disease, sleep disorders) is well documented and has gained much attention in the past decade (e.g., Black, 2003; Chandola, Brunner, & Marmot, 2006; Froom, Melamed, Kristal-Boneh, Gofer, & Ribak, 1996; Kyrou, Chrousos, & Tsigos, 2006; Wardle, Chida, Gibson, Whitaker, & Steptoe, 2011). Additionally, obesity has been shown to have important undesirable work related impacts in terms of discrimination against obese people, especially women, in hiring (Pingitore, Dugoni, Tindale, & Spring, 1994), more negative evaluations and expectations of obese trainees' effectiveness by trainers (Shapiro, King, & Quinones, 2007), and reduced annual salary (Judge & Cable, 2011). The etiology of obesity is multifaceted, involving environmental, genetic, neuro-endocrinological, behavioral, social, cultural, and psychological factors (Karasu, 2012; Wardle et al., 2011). One of the environmental factors at work that may potentially contribute to stress related obesity is employees' job design. However, we do not know specifically how job design (e.g., degree of job enrichment) may contribute to obesity. Here, we focus specifically on the effect of job enrichment, as manifested in a combined measure of the core job characteristics of variety, identity, significance, autonomy, and feedback (e.g., Champoux, 1980, 1992; Fried & Ferris, 1987; Xie & Johns, 1995), on changes of two measures of abdominal obesity over time: waist circumference (WC) and waist-hip ratio (WHR). These measures have been shown to be sensitive to the influence of environmental stimuli and have been found to be robust predictors of health criteria such as cardiovascular-related diseases (e.g., Janssen, Katzmarzyk, & Ross, 2004; Klein et al., 2007). Although we also investigate the impact of job enrichment on the

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Please note that Professor Arie Shirom is now deceased.

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well-known measure of body mass index (BMI), we do not anticipate an impact on BMI as it has been shown to be relatively stable and less susceptible to changes due to environmental stimuli (Finucane et al., 2011).

We propose, based on activation theory (Levi, 1972; Scott, 1966; Xie & Johns, 1995) and evidence from the field of human physiology (e.g., DeAngelis, 2002; Gardner, 1986; Gardner & Cummings, 1988; Kyrou, Chrousos, & Tsigos, 2006), that job enrichment has a U-shaped curvilinear effect on the indicators of obesity. That is, a moderate level of job enrichment is expected to result in reduced obesity, and lower or higher levels of job enrichment are expected to result in an increase in obesity (cf., Ferris et al., 2006; Grant & Schwartz, 2011). In the present study we use a longitudinal design to examine these curvilinear relationships.

Time represents a necessary consideration in reference to the proposed effect of job characteristics on physiological or health related outcomes (cf., Ferris et al., 2006; Fried, Grant, Levi, Hadani, & Slowik, 2007; Grant & Schwartz, 2011; Griffin, 1991; Mitchell & James, 200l; Shirom, Melamed, Rogowski, Shapira, & Berliner, 2009; Wardle et al., 2011). This is because, generally, changes in health or somatic outcomes such as obesity take time to occur (e.g., Kvaavik, Tell, & Klepp, 2003; Livshits et al., 2012). Furthermore, longitudinal studies permit inference of causality (Zapf, Dormann & Frese, 1996). Therefore, in the current study we use a longitudinal design with two measurements over close to 3.5 years (on average) to investigate how job enrichment associated with the combined measure of the core job characteristics of variety, identity, significance, autonomy, and feedback (Fried & Ferris, 1987; Hackman & Oldham, 1980; Sims, Szilagyi, & Keller, 1976) contributes to changes in the important somatic outcome of abdominal obesity.

The Curvilinear Effect of Job Enrichment on Obesity

The area of work design has generated much interest and research during the past few decades (e.g., Fried & Ferris, 1987; Grant, 2008; Grant, Fried, & Juillerat, 2010; Grant, Fried, Parker, & Frese, 2010; Grant & Parker, 2009; Humphrey, Nahrgang, & Morgeson, 2007; Morgeson & Campion, 2003; Oldham, 1996; Parker & Wall, 1998; Parker, Wall, & Cordery, 2001; Taber & Taylor, 1990). Within the realm of the job characteristics literature, the Job Characteristics Model (JCM; Hackman & Oldham, 1980) gained the attention of numerous researchers. This model focuses on five main, core job dimensions (e.g., Hackman & Oldham, 1980; Humphrey et al., 2007), including variety (which refers to a range of capabilities and tasks used on the job), identity (which refers to the completion of a whole piece of work), significance (which refers to the effect of the job on the well-being of other people), autonomy (which refers to freedom and discretion in how and when to do the work), and feedback (which refers to information about performance effectiveness from the job itself or from others). Enriched jobs are those that have higher levels of these core job characteristics, as manifested in the combined measure of these five characteristics (e.g., Fried & Ferris, 1987; Fried, Levi, & Laurence, 2008).

Theoretically, the literature on job design has suggested a positive linear relationship between high levels of job enrichment and employees' favorable behavior and attitudes. These postulated relationships are attributed to the positive psychological experiences associated with the stimulation and challenge of enriched jobs (see, e.g., Fried et al., 2008; Hackman & Oldham, 1980). Jobs that are low in enrichment may be perceived as a source of stress (e.g., Xie & Johns, 1995), due to the employee's experience of boredom, low control, low feedback, and lack of meaning and identity at work. Jobs that are very high in job enrichment may also be perceived by the employee as a source of stress, as such jobs are often characterized by a heavy workload and intense, demanding, fast-paced, and high-stakes tasks (Hewlett & Luce, 2006). We thus expect both very low and very high levels of job enrichment to contribute to impaired health.

Furthermore, based on activation theory (Gardner & Cummings, 1988; Levi, 1972; Scott, 1966; Xie & Johns, 1995) and evidence borrowed from the field of human physiology (e.g., DeAngelis, 2002; Gardner, 1986; Gardner & Cummings, 1988; Kyrou, Chrousos, & Tsigos, 2006) we argue that job enrichment can be expected to have a curvilinear relationship with adverse somatic outcomes such as obesity, such that when job enrichment is low or high, obesity will be highest.

Activation theory suggests a curvilinear relationship between experienced activation level and central nervous system efficiency (e.g., Levi, 1972). According to activation theory, people have optimal characteristic levels of activation, and when their experience of activation level significantly deviates from this optimal characteristic level, they experience stress, which leads to adverse mental, behavioral, and somatic outcomes (e.g., Gardner, 1986; Gardner & Cummings, 1988). Applying activation theory to the area of job design suggests that a deviation from the optimal characteristic level of activation, which, in turn, produces the experience of stress, may occur when job enrichment is either too low or too high. In earlier research in the organizational realm, scholars proposed an inverted U-shaped relationship between job enrichment and task performance (Gardner, 1986) and between job enrichment and employees' satisfaction and motivation (Champoux, 1978, 1980; French, Caplan, & Van Harrison, 1982). Extending this research, Xie and Johns (1995) hypothesized and found empirical support for a U-shaped relationship between job enrichment and emotional exhaustion. As Xie and Johns (1995) explain, low levels of job enrichment can be expected to be related to monotony and understimulation; this is essentially the situation of underload that has been described above to be positively related to various negative somatic outcomes. At the same time, it can be expected that high levels of job enrichment will also be associated with higher levels of stress related to overstimulation (representing a situation of high overload) caused by high levels of responsibility and mental demands, resulting in negative somatic outcomes (e.g., Martin & Wall, 1989; Schaubroeck & Ganster, 1993). Such stress related overstimulation can be expected to occur when completing the job requires the use of too many skills or tasks (high variety), the responsibility for too many processes from beginning to end (high identity), or the experience of too much responsibility for outcomes (high significance; e.g., Champoux, 1980, 1992; Xie & Johns, 1995). Similarly, too much choice (associated with high autonomy), may cause stress related decision paralysis (see, e.g., Grant, & Schwartz, 2011), and the growing use of electronic job feedback (electronic performance monitoring) may lead to a situation of too much feedback, associated with high cognitive overload (e.g., Parker et al., 2001).

However, as noted above, the literature has failed to focus on the pattern of the relationship between job enrichment and health or somatic related outcomes (e.g., Fried et al., 2008). As suggested above, either high levels or low levels of job enrichment may serve as a stressor, as they reflect both underload, in which work is monotonous and boring, and excessive overload, in which the work is over stimulating and demanding. Both underload and overload have been shown to be risk factors for ischemic heart disease (Belkic, Landsbergis, Schnall, & Baker, 2004; Melamed, Ben-Avi, Luz, & Green, 1995) and other health-related outcomes (Frankenhaeuser & Gardell, 1976; Karasek & Theorell, 1990). Overall, very few studies have focused on the relationship between job enrichment and somatic outcomes. Moreover, these few studies (Melamed, Fried, & Froom, 2001; Schaubroeck, Ganster, & Kemmerer, 1994) have adopted a linear rather than a curvilinear approach. However, both Melamed, Fried, and Froom (2001) and Schaubroeck, Ganster, and Kemmerer (1994) failed to support a linear main effect of job enrichment on cardiovascular outcomes. To add to this evidence, a recent meta-analysis by Wardle, Chida, Gibson, Whitaker, and Steptoe (2011) failed to provide support for the linear relationship between psychological work stressors and obesity. This meta-analysis, which covered studies published between 1988 and 2009, reported only a handful of studies that focused on work related stressors (e.g., work control, dissatisfaction, insecurity) and indicators of obesity.

It may be that the failure to support a relationship between potential causes of stress and obesity is related to the fact that most studies have failed to systematically consider a curvilinear relationship between these variables. Extending the previous literature we now discuss the expected rationale for the curvilinear relationship between job enrichment and obesity. The literature on human physiology suggests that the experience of stress would result in hormonal changes associated with potentially adverse somatic outcomes, including increased obesity (Bose, Oliván & Laferrére, 2009; Magiakou & Chrousos, 2005). In the context of our study this means that, over time, the experience of stress associated with high job enrichment contributes to increases in stress hormones with potential adverse effects on somatic indicators such as abdominal obesity (e.g., Chrousos, 1995). This is consistent with evidence supporting the association between psychological stress and strain and increases in abdominal obesity (e.g., Black, 2003; Toker, Shirom, & Melamed, 2008). The experience of stress, primarily through perturbation of the hypothalamic-pituitary-adrenal (HPA) axis, appears to contribute to increases in abdominal obesity through the accumulation of fat tissue (Kyrou, Chrousos, & Tsigos, 2006). Chronic exposure to stress and HPA axis activation can be potentially damaging because of the prolonged glucocorticoide (cortisol hormone in humans) action on the expression of important genes implicated in several crucial metabolic pathways, which is expected to progressively increase abdominal obesity and decrease lean body (muscle and bone) mass (Black, 2003; Kyrou, Chrousos & Tsigos, 2006; Magiakou & Chrousos, 2005). An interesting study by Chandola, Brunner, and Marmot (2006) indicated that employees with chronic work stress were found to have a more than twofold risk of the metabolic syndrome that includes abdominal obesity, even after adjusting for age, employment grade, and health behaviors such as diet and physical activities. Abdominal obesity has been shown to be an important contributor to certain diseases and bodily disorders such as insulin resistance, the metabolic syndrome, Type 2 diabetes, chronic inflammatory process, and atherosclerosis and subsequently cardiovascular disease (Black, 2003). In addition, individuals who are engaged in demanding and over stimulating, highly enriched jobs may not maintain a healthy diet and timely eating habits which may contribute to obesity (e.g., Moore & Cunningham, 2012; Nishitani, Sakakibara, & Akiyama, 2009).

Further, consistent with activation theory (Levi, 1972), individuals in jobs low on enrichment can be expected to experience negative outcomes because these individuals are likely to feel underutilized and underappreciated, with no opportunities for personal growth and development. Similarly to negative outcomes related to the experience of overload discussed above, the experience of underload may also produce an increase in stress related hormones, resulting in subsequent obesity and other adverse health related outcomes. Indeed, evidence suggests the role underload is associated with increased levels of health risk factors (e.g., Melamed et al., 1995). In addition to the above, low levels of job enrichment are likely to result in boredom (Gardner, 1990), and boredom has been found to be associated with compensatory overeating, leading, in turn, to obesity (Sullivan, Cloninger, Przybeck, & Klein, 2006). Based on the above it also follows that obesity will be lower when job enrichment is moderate, and higher when job enrichment is either low or high.

In sum, we argue that both low and high job enrichment will result in an increase in abdominal obesity. This leads to the following hypothesis:

> *Hypothesis:* Job enrichment will have a U-shaped effect on changes in abdominal obesity (WC and WHR) over time. Obesity will increase when job enrichment is low or high, and will decrease when job enrichment is moderate.

Method

Sample

This study took place between 2003 and 2009 in the Tel Aviv Sourasky Medical Center for routine health examinations. The study participants were examinees who had voluntarily agreed to participate in the Tel Aviv Medical Center Inflammation Survey (TAMCIS) cohort study. The physical examination was sponsored or subsidized by employers as a fringe benefit (for about 40% of the sample), or as a mandatory examination for employees in the public sector (for about 60% of the sample), and each employee, independent of health status, was eligible to attend these examinations every 12–36 months until retirement. During this period 4,556 employees attended the center and were invited to participate in the study. Ninety-one percent agreed, resulting in an initial sample of 4,146 participants (T1). Based on patient medical records, we did not find any significant differences between participants and nonparticipants in terms of any of gender, age, or obesity. Participants' visits to the medical center were recorded until 2009, and were available to the research staff. If participants did not return for a second visit within 36 months, the medical center's staff contacted them via postal mail or phone calls, regardless of medical examination results, and invited them to repeat the examination. Forty-seven percent (1,949 participants) returned for a second visit (T2). The psychological, somatic, and anthro-

pometric measures used in this study were taken from each participant during their two visits. On average, their second visit took place after close to 3.5 years ($M = 40$ months; $SD = 40$). The 53% who did not return for a second visit were more likely to be male, older employees close to retirement, employees who reported having a chronic disease at T1 and spent less time on regular exercise activity at T1. We chose to extend the measures between T1 and T2 to such a long interval, in order to ensure our ability to capture the typically slowly evolving changes in the focal somatic outcomes we focused on as dependent variables.

To ensure a healthy population for the study we excluded 1,333 participants for one of the following reasons: We excluded those respondents who reported having had a cardiovascular disease, diabetes, cancer, a stroke, a mental crisis, bodily inflammation, or extreme values of microinflammation protein C-reactive protein (i.e., $>$ 10.0 mg/L because these values indicate an acute inflammatory response to infection that could elevate blood lipid levels), or participants who reported regularly taking medications including antidepressants, statins or any other lipid-lowering drug, aspirin, steroids, and antibiotics. These individuals were excluded because these diseases and medications have the potential to impact the levels of the study's criteria. For example, some types of illnesses, or medications taken to treat them, are associated with weight gain yet other types (e.g., cancer) are associated with weight loss (e.g., Flegal, Graubard, Williamson, & Cooper, 2011). We also excluded participants who had reported not being gainfully employed, working less than 3 hours per day, or who reported that they had changed either their employer or their job between the two measures. This ensured that all of the participants were employed in the same job and by the same organization over the entire term of the study. These eliminations resulted in a sample size of 616. The participants in the study worked in a variety of occupations such as teaching, technical, engineering, administrative, academic, computer, medical, service, secretarial, sales, and blue collar jobs. On average, respondents were about 45 years old ($SD = 9.3$ years), with about 16 years of formal education, 13 years with their companies, and 9 years in their current positions. Thirty-three percent were female.

Procedure

An interviewer recruited participants while they were waiting for their clinical examination. Participants signed a written informed consent form, and in return for their participation were promised detailed feedback. The periodic health examination at the medical center consisted of serum sampling, anthropometric measurements, a physical examination, urinalysis, and a stress electrocardiogram. The study was approved by the Institutional Review Boards of the Sourasky Medical Center and the Tel Aviv University Faculty of Medicine.

Measures

The questionnaire used in this study provided information on the participants' backgrounds, occupational factors, psychological factors, and physical morbidity factors. Table 1 provides descriptive statistics including means, standard deviations, and intercorrelations of the measures used.

All measures described below were assessed at each of the visits, except for the job enrichment scales (variety, identity, significance, autonomy, and feedback), which were assessed only at T1. However, because all employees in the study were employed in the same job and by the same organization during the two measurement periods, our assumption is that the responses for these job characteristics at T1 validly represent the conditions of these job characteristics at both times (cf., Gerhart, 1987). Also supporting this assumption was the fact that the participants in the study had worked in their jobs for an average of close to 9 years at T1, which raises the likelihood that after so many years job characteristics had stabilized and remained similar in future time periods.

Table 1
Descriptive Statistics and Correlations

Variables	Mean	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Gender (male = 0, female = 1)	0.33	0.47	–																
2. Age	44.80	9.33	.01	—															
3. Education	15.89	2.67	−.16*	.10*	—														
4. Organizational tenure	12.88	9.18	.11*	.53*	−.15*	—													
5. Job tenure	9.23	7.85	.10*	.45*	−.15*	.70*	—												
6. Diet (no special diet = 0, special diet = 1)	0.27	0.44	.08	.14*	.05	.15*	.14*	—											
7. Cigarettes/day	1.52	4.77	.08	.03	−.07	.05	−.00	−.01	—										
8. Alcohol/week	1.21	2.05	−.16*	.03	.11*	−.06	−.09*	.07	.11*	—									
9. Sport intensity	2.75	3.03	−.05	.11*	−.02	.14*	.15*	.14*	−.08	.15*	—								
10. T2–T1 time lag, (days)	1241.42	435.43	.12*	−.09*	−.10*	.11*	.05	−.01	−.01	−.03	−.10*	—							
11. T1 waist circ.	89.23	11.66	−.59*	.23*	−.08*	.10*	.14*	.05	−.03	−.02	−.08	−.10*	—						
12. T2 waist circ.	90.00	11.81	−.51*	.21*	.06	.08	.13*	.08	−.02	−.02	−.07	−.09*	.80*	—					
13. T1 WHR	0.96	0.11	−.61*	.26*	.09*	.10*	.08*	.02	−.04	.01	−.09*	−.07	.77*	.63*	—				
14. T2 WHR	0.92	0.11	−.56*	.22*	.06	.03	.08*	.04	−.05	.03	−.03	−.18*	.60*	.79*	.60*	—			
15. T1 BMI	25.68	3.41	−.27*	.22*	−.00	.15*	.18*	.12*	−.04	−.03	−.02	−.05	.77*	.69*	.50*	.38*	—		
16. T2 BMI	25.83	3.46	−.22*	.21*	−.03	.15*	.19*	.17*	.02	−.06	−.03	−.01	.70*	.74*	.44*	.41*	.90*	—	
17. Job enrichment	3.86	0.56	−.17*	.16*	.01	.09*	.07	.07	.06	.07	.06	−.03	.17*	.13*	.19*	.14*	.11*	.10*	.78

Note. $N = 616$, Cronbach's alpha of Job Complexity is indicated on the diagonal.
* Indicates significance at $p < .05$.

Outcome variables. Two specific measures of abdominal obesity used in the literature are waist circumference and waist-hip ratio (e.g., Fogelholm et al., 2006; Yusuf et al., 2005). Although waist circumference and waist-hip ratio may be expected to be highly correlated, there is evidence that supports their differential effect on health related outcomes and as such there is support for examining them independently. For example, although waist-hip ratio has been shown to be a more efficient predictor of mortality than waist circumference, waist circumference appears to be a better predictor of cardiovascular risk factors than waist-hip ratio (Fogelholm et al., 2006; Picon et al., 2007; Price, Uauy, Breeze, Bulpitt, & Fletcher, 2006). For comparative purposes, in addition to the two criteria of waist circumference and waist-hip ratio we also investigate the impact of job enrichment on the general obesity measure of body mass index (BMI). Measures of abdominal obesity are considered to be more sensitive to environmental stimuli and health related indicators than body mass index (e.g., Black, 2003; Fogelholm et al., 2006), which, in turn, suggests that our hypothesis on the effect of job enrichment will be less likely to apply to the measure of body mass index (cf. Black, 2003; Fogelholm et al., 2006; Janssen et al., 2004; Yusuf et al., 2005). The three indicators of obesity were measured as follows:

Waist circumference. Waist circumference represents the circumference of each subject's waist in centimeters.

Waist-hip ratio. Waist-hip ratio is calculated as waist circumference in centimeters divided by hip circumference in centimeters.

Body mass index. Body Mass Index was calculated as the individual's weight in kilograms divided by the square of his or her height in meters.

All weight measures were measured without clothes by certified, specially trained nurses.

Predictor variables.

Job enrichment. Fifteen items assessed the variables of variety (skill and task variety), identity, significance, autonomy, and feedback (job and supervisory). The items were based on Hackman and Oldham's (1975, 1980) Job Diagnostic Survey (JDS) and the Sims, Szilagyi, and Keller (1976) Job Characteristics Inventory (JCI). Factor and reliability analyses have confirmed the psychometric properties of these scales. Variety (consisting of skill variety and task variety) was assessed by four items. Two sample items (one for skill variety and the other for task variety) are: "My work provides me opportunities to utilize my various skills" and "My work provides me opportunities to work on a wide variety of things." Cronbach's alpha for job variety was .89. Identity was assessed by two items. One sample item is: "My work is organized such that I can work on something complete from beginning to end." Cronbach's alpha for identity was .75. Significance was assessed by three items. One sample item from this scale is: "The way that I am doing my work affects other people." Cronbach's alpha for significance was .84. Autonomy was assessed by three items. One sample item is: "I have considerable opportunity for freedom and independence from other employees in how I do my work." Cronbach's alpha for autonomy was .65. Feedback from the job and supervisor was assessed by three items. One item indicating feedback from the job is: "Doing the work provides many chances for me to figure out how well I am doing." A sample item for feedback from the supervisor is: "Supervisors often let me know how well they think I am performing the job." Cronbach's alpha for feedback was .85. Each of the scales was assessed on a 5-point scale ranging from 1 (*untrue to a very large extent*) to 5 (*true to a very large extent*) (see also Fried & Shirom, 1984). The measure of job enrichment was calculated as the average of the items of these five scales of variety, identity, significance, autonomy, and feedback (Fried & Ferris, 1987). Cronbach's alpha for the combined job enrichment scale was .78. Job enrichment has typically been measured by summing or averaging the scales for the core job characteristics, such that high scores represent high levels of enrichment and low scores indicate low levels of enrichment (cf. Fried & Ferris, 1987; Fried et al., 2008; Xie & Johns, 1995). Combining these core job characteristics scales into one single measure results in a measure with higher predictive power than using each of the individual job characteristics (e.g., Fried & Ferris, 1987). We further note that previous studies that have focused on the curvilinear effect of job design on psychological and behavioral outcomes (e.g., Champoux, 1978, 1980, 1992; Gardner, 1986; Xie & Johns, 1995) have also used a combined measure of the core job characteristics (an average or sum of the job characteristics' scales) to assess job enrichment.

Control variables. We controlled for participants' age, gender, education (number of years of formal education), organizational and job tenure, job type, intensity of sports activity, number of cigarettes smoked per day, weekly alcohol consumption, diet, the number of days between measurements, and waist circumference, waist-hip ratio, and body mass index at Time 1. Age has been shown to be related to a decline in physical functioning which affects obesity (Villareal, Apovian, Kushner, & Klein, 2005). Gender (coded as male = 0 and female = 1) was controlled because men and women differ in their weight and how potential predictors affect their weight (e.g., Armon, Shirom, Berliner, Shapira, & Melamed, 2008). Education tends to be related to socioeconomic status, lifestyle, and eating habits that may affect weight. Organizational tenure may affect individuals' level of job enrichment, availability of resources to pursue the job assignments, and attitudes and mental experiences at work (e.g., Chao, O'Leary-Kelly, Wolf, Klein, & Gardner, 1994; Katz, 1978), which may affect the experience of stress. Also concerning organizational and job tenure (number of years working for the current organization and job), in the epidemiological literature, tenure represents a proxy variable for stress exposure. Thus, employees who are working in jobs high on complexity and demand may, over time, find it increasingly more difficult to cope with the exceeding information overload the job produces (cf., Fried et al., 2007; Hall, 1996; Katz, 1978). We controlled for job type due to its potential impacts on the varying levels of job enrichment that can be expected from jobs of different types (Morgeson, Dierdorff, & Hmurovic, 2010). Twelve categories of job types were used as controls (e.g., "teacher, academic," "technical, engineering, computer," "administration," and "selling and customer service"). As this job type was included as a categorical control variable, it does not appear in Table 1 (Descriptive Statistics and Correlations). We also controlled for amount of sport activity (number of hours per week engaged in physical activity), number of cigarettes smoked per day, weekly alcohol consumption (number of alcoholic drinks consumed per week), and diet (an affirmative answer indicating that the participant did not use any special diet such as a low fat, low salt, or low carbohydrate diet) because of their potential effect on obesity (e.g., Andersen,

Crespo, Bartlett, Cheskin, & Pratt, 1998; Epel et al., 2000; Epel et al., 1999; Fogelholm & Kukkonen-Harjula, 2000; Kronenberg et al., 2000; Moyer et al., 1994; Steptoe, Brydon, Kunz-Ebrecht, & Wardle, 2004; Wallerius, Rosmond, Ljung, Holm, & Bjorntorp, 2003). The number of days between measurements was assessed to control for potential differences in measurements due to the time lag between these measurements. Finally, to test for changes in the obesity measures (WC, WHR, and BMI) at T2 in our study we controlled for these measures at T1.

Results

In order to test our hypotheses concerning the curvilinear effect of job enrichment on the indicators of abdominal obesity, we conducted a series of hierarchical regression analyses. We investigated the effect of job enrichment on abdominal obesity at Time 2 as this allowed us to more effectively assess the causality of the proposed relationship. In order to do this, we controlled for abdominal obesity at Time 1 in addition to controlling for gender, age, education, organizational and job tenure, and other variables as noted above. For each dependent variable, the control variables were entered first, followed by the main, linear effect of job enrichment, and then the quadratic effect of job enrichment. The results, as indicated in Tables 2 and 3, supported the curvilinear effect of job enrichment on changes in waist circumference and waist-hip ratio at T2 of our measurements ($\beta = .11$, $p = .00$ and $\beta = .13$, $p = .00$, respectively), offering support for our hypothesis. Table 4 indicates that, as expected, the curvilinear effect of job enrichment was not a significant predictor of changes over time in body mass index ($\beta = -.01$, $p = .45$).

In order to test the shape of the curvilinear relationship, we plotted the curves between 2 standard deviations below and 2 standard deviations above the mean value of job enrichment (see Figures 1–2). The figures provide further support for our hypothesis, indicating that as job enrichment increases and approaches mean levels, both waist circumference and waist-hip ratio decrease and as job enrichment increases above mean levels, both waist circumference and waist-hip ratio increase.

Table 3
The Curvilinear Effect of Job Enrichment on Waist-Hip Ratio at T2 (Controlling For T1)

Variable	T2 waist-hip ratio		
	Model 1	Model 2	Model 3
Gender	−.36*	−.36*	−.37*
Age	.14*	.14*	.14*
Education	−.07*	−.07*	−.06*
Organizational tenure	−.11*	−.11*	−.10*
Job tenure	.10*	.09*	.08
No special diet	.05	.05	.04
No. cigarettes per week	−.01	−.01	−.01
Alcohol consumption	−.03	−.03	−.03
Sport intensity	−.04	−.04	−.05
Job category	−.01	−.01	−.02
T2–T1 time lag	−.11*	−.11*	−.11*
T1 waist hip ratio	.35*	.35*	.34*
Job enrichment		−.01	.03
Job enrichment ^ 2			.13*
R^2	.47*	.47*	.48*
ΔR^2	.47*	.00	.02*

Note. $N = 616$; Regression Coefficients are Standardized Betas.
* Indicates significance at $p < .05$.

Discussion

This study fills voids in the job design literature on a number of issues. Specifically, the literature has called for extending the outcome variables associated with job characteristics to broader indicators of employee well-being (e.g., Gillespie, 2009; Kanfer, 2009). We answered that call by examining the impact of job design on two important, stress related indicators of abdominal

Table 2
The Curvilinear Effect of Job Enrichment On Waist Circumference at T2 (Controlling For T1)

Variable	T2 waist circumference		
	Model 1	Model 2	Model 3
Gender	−.11*	−.11*	−.12*
Age	.06	.06*	−.06*
Education	−.03	−.03	−.03
Organizational Tenure	−.06	−.06	−.05
Job tenure	.05	.05	.04
No special diet	.05	.05	.04
No. cigarettes per week	.01	.01	.01
Alcohol consumption	−.02	−.02	−.02
Sport intensity	−.02	−.02	−.03
Job category	−.03	−.03	−.03
T2–T1 time lag	−.01	−.01	−.01
T1 waist circumference	.72*	.72*	.72*
Job enrichment		−.02	.01
Job enrichment ^ 2			.11*
R^2	.65*	.65*	.66*
ΔR^2	.65*	.00	.01*

Note. $N = 616$; Regression Coefficients are Standardized Betas.
* Indicates significance at $p < .05$.

Table 4
The Curvilinear Effect of Job Enrichment on Body Mass Index at T2 (Controlling For T1)

Variable	Body Mass Index		
	Model 1	Model 2	Model 3
Gender	−.00	−.00	−.00
Age	.02	.02	.02
Education	−.02	−.02	−.02
Organizational tenure	−.04	−.04	−.04
Job tenure	.03	.03	.03
No special diet	.06*	.06*	.06*
No. cigarettes per week	.06*	.06*	.06*
Alcohol consumption	−.04*	−.04*	−.04*
Sport intensity	−.00	−.00	−.00
Job category	−.01	−.01	−.01
T2–T1 time lag	.04*	.04*	.04*
T1 body mass index	.89*	.89*	.89*
Job enrichment		−.01	−.01
Job enrichment ^ 2			−.01
R^2	.82*	.82*	.82*
ΔR^2	.82*	.00	.00

Note. $N = 616$; Regression Coefficients are Standardized Betas.
* Indicates significance at $p < .05$.

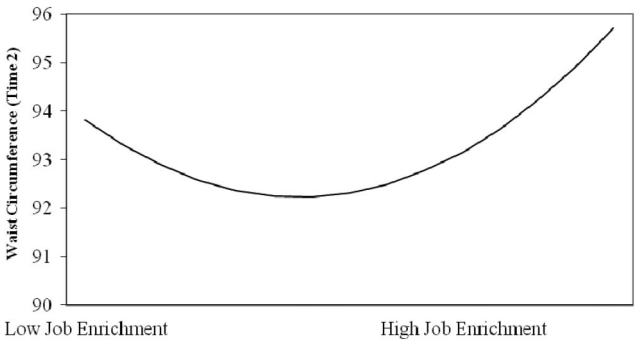

Figure 1. Curvilinear Effect of Job Enrichment on T2 Waist Circumference (T1 Controlled).

obesity (waist circumference and waist-hip ratio). Focusing on stress related abdominal obesity as an outcome of job characteristics is particularly important in the modern world where increasing levels of obesity in the population have become a serious societal problem with serious health and social implications (e.g., Janssen et al., 2004; Judge & Cable, 2011; King, Shapiro, Hebl, Singletary, & Turner, 2006; Klein et al., 2007; Pingitore et al., 1994; Shapiro et al., 2007). The results of this study support the importance of future research focusing on health related indicators as outcomes of job characteristics.

Moreover, we further expanded on the existing premises of the job design literature concerning the linear relationship between job characteristics and employee reactions, by hypothesizing a curvilinear effect of job enrichment in the form of a U-shaped effect on the development of health related somatic outcomes. We note that a number of scholars have argued and provided some support for the notion that job enrichment may have a curvilinear, rather than a linear, relationship with employee psychological or behavioral related outcomes (e.g., Champoux, 1978, 1980; de Jonge, Reuvers, Houtman, & Kompier, 2000; Elsbach & Hargadon, 2006; Ferris et al., 2006; Gardner, 1986; Valentine, 1999; Warr, 1987; Xie & Johns, 1995). However, research has not extended the curvilinear approach to examine the relationship between job enrichment and the development of somatic outcomes.

In this study we provided support for our hypothesized curvilinear effect of job enrichment on two key stress related obesity indicators over time: waist circumference and waist-hip ratio. In order to examine the effect of job enrichment on obesity over time, we conducted a longitudinal study in which the time length between the measurement of obesity at T1 and T2 lasted, on average, close to 3.5 years. The results suggest that job design tends to have an adverse effect on changes in the two abdominal obesity measures over time when the level of the job enrichment is either too low or too high.

The fact that job enrichment affects both measures of abdominal obesity is important, because although typically correlated with each other, these two measures also tend to have differential effects on health-related outcomes. This, in turn suggests that job enrichment through its effect on both waist circumference and waist-hip ratio affects broader health indicators than if it had an effect on only one of the two abdominal indicators. In addition, as noted, for comparative analysis we also included the total obesity measure of BMI. Consistent with our expectations, job enrichment was not related to changes in the general obesity measure of BMI. As proposed in our introduction. the results concerning BMI can be expected given the weaker relationship reported in the literature between environmental stimuli and BMI (e.g., Finucane et al., 2011). Moreover, the recent literature on obesity has raised a number of concerns regarding using BMI as an indicator of obesity. For example, it may result in an inaccurate estimate of obesity because a muscular individual is likely to have a higher BMI without being unfit. Similarly, it may result in an underestimation of obesity for older populations as they tend to experience a loss in muscle mass (Ness-Abramof & Apovian, 2008). These measurement issues may, at least partially, explain the lack of an observed relationship between job enrichment and BMI in our study.

This study's findings also provide beneficial information to managers. They suggest that managers should be aware that although research clearly suggests that challenging (enriched) jobs are associated with positive psychological and behavioral outcomes, they might also, as time progresses, adversely affect abdominal obesity, which may further enhance the risk of health problems. Managers should be similarly aware that low job enrichment, in addition to contributing to negative psychological and behavioral outcomes, may also progressively affect employees' physical health in a negative way. This suggests that management should intervene to affect the level of job characteristics to maintain low abdominal obesity. In this context we note that the term job enrichment not only refers to the nature of the job characteristics, but can also be an intervention itself, aimed at optimizing the level of job characteristics (cf., Bakker & Demerouti, 2007). For example, based on the Job Demands-Resources Model, Bakker and Demeroti (2007) suggest that through qualitative and related quantitative analyses of employees' responses, organizations can detect the strengths and weaknesses of departments and job positions. This information can then be followed by tailor-made interventions aimed at reducing the identified job demands and enhancing the most important job resources. Similarly, according to the demand-control model, stress occurs when psychological job demands are high and decision latitude is low (Karasek, 2004). Based on 19 international case studies, Karasek (2004) reported that implementing organizational interventions that involve workers' participation, open communication channels between labor and management, and a learning approach to stress are keys for preventing stress and enhancing productivity at work.

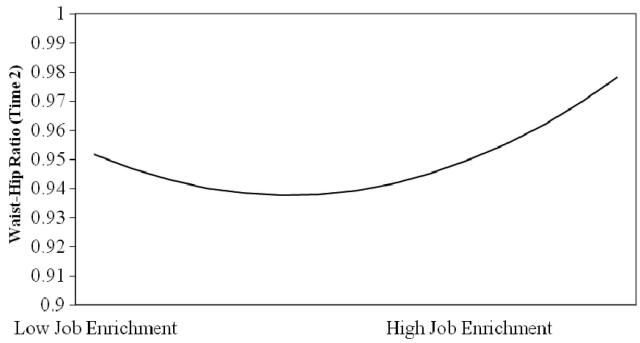

Figure 2. Curvilinear Effect of Job Enrichment on T2 Waist-Hip Ratio (T1 Controlled).

Similarly, in our context, using methods such as surveys from employees and observations by managers, organizations may look to determine when job enrichment is too low or too high. Following this information, these organizations can then take steps in collaboration with employees to adjust the level of job characteristics associated with job enrichment, to help facilitate the appropriate activation level resulting in lower obesity and improved health. For example, low job enrichment is often associated with low skill variety and task identity. Enhancing the levels of these and other job characteristics as needed, would not only improve attitudes and performance as previous studies in the literature have indicated, but, as our results suggest, would also reduce the likelihood of abdominal obesity and consequent health related indicators. Similarly, organizations may intervene to reduce the level of job enrichment when it is too high, as often found in "extreme jobs." For example, employees may have too much work autonomy, or they may be responsible for too many processes at work from beginning to end (high task identity) that may paralyze their ability to function (cf., Grant & Schwartz, 2011). Again, optimizing the level of job characteristics is expected to positively affect obesity and health related outcomes. Moreover, there is evidence that appropriate diet and physical activities tend to reduce body weight and the risk of having metabolic syndrome (e.g., Zhu, St-Onge, Heshka, & Heymsfield, 2004). This supports a preventive policy in which organizations encourage and incentivize employees to adopt a healthy diet and physical activities. Thus, for example, management may take steps to implement or reward participation in wellness or other health related programs.

Strengths, Limitations, and Future Research

The present study is unique among studies investigating the relationship between job design and somatic outcomes in that it is longitudinal in nature, assessing the relationship between job design and changes in multiple measures of obesity over time. Most studies on stress and body weight have been cross-sectional in nature, and many of these relied on self-report data on weight (Overgaard, Gamborg, Gyntelberg, & Heitmann, 2004). This study, therefore, provides important evidence on how job design is related to changes in the key criterion of abdominal obesity. Moreover, the fact that we controlled for 11 covariates that are related to both job enrichment and obesity, and still found significant results is noteworthy. Therefore, given our conservative approach in which we controlled for these 11 potential covariates, the effect size found in this study may represent the lower bound of the true effect size.

However, the present study also has some limitations that should be addressed by future studies. For example, we lack data on the physiological health processes that may mediate the relationship between job characteristics and abdominal obesity. In addition, the data on diet and physical exercise were lacking some specific details that limited our ability to study the potential main or moderating effects of these variables on changes in abdominal obesity. In particular, we lacked data on peoples' specific diets and eating habits, which are important determinants of obesity (Du & Feskens, 2010). Although we did have self-report information on participants' physical activity (number of hours of sport activity per week) we lack information on the intensity of these physical activities. For example, some people may exercise fewer hours per week than others, but their physical activities may be more intense, resulting in a stronger effect on abdominal obesity. Finally, our data on job characteristics was measured only once, at T1. Therefore, we cannot say with absolute certainty that individuals' job characteristics are completely stable over time. Although job characteristics may be stable over time when employees do not change their jobs (e.g., Gerhart, 1987), there is also evidence indicating that employees may change (craft) the characteristics of their jobs over time (e.g., Grant & Parker, 2009; Wrzesniewski & Dutton, 2001). However, the fact that the participants in our study worked in the same job and for the same organization for an average of close to 9 years prior to the T1 measurement and did not change jobs or employers during the course of the study, increases our confidence that the measurement of job characteristics at T1 validly reflect the job characteristics levels at the time data was collected again. Future research will benefit from replicating this study in other samples. Moreover, evidence on obesity based discrimination (e.g., Carr & Friedman, 2005; Judge & Cable, 2011), may support a test on reverse causation in which obese people are more likely to be selected for or placed in impoverished jobs, low on complexity.

In sum, the present study contributes to the literature by showing that job enrichment, which is typically discussed in the organizational behavior literature as a positive phenomenon, may contribute negatively to employee health related indicators. Thus, although the organizational behavior literature supports the hypothesized positive relationship between job characteristics and psychological and behavioral outcomes, our study points out that simultaneously with these positive effects, job enrichment may also have negative effects on employees' health related indictors. In this study we have expanded our knowledge on the effect of job design on abdominal obesity, specifically. The curvilinear relationship of job enrichment with changes in waist circumference and waist-hip ratio helps illuminate the pattern in which job design contributes to abdominal obesity over time, an important distal somatic work outcome.

We hope that this study will provide an impetus for future studies to further explore the apparent complex, nonlinear effect of job enrichment on employee somatic indicators to expand on the knowledge produced in our study. In addition, we encourage researchers to examine the effect of potential moderators on the curvilinear relationship between job enrichment and somatic outcomes. A healthy diet and lifestyle come to mind as potentially important moderators. Moreover, it will be interesting to explore what steps individuals tend to pursue in response to adverse somatic outcomes associated with low and high job enrichment. For example, it may be that these individuals would be more likely to pursue proactive behaviors to change their job characteristics (increase job stimulation when job enrichment is low and reduce job enrichment when job enrichment is too high) to mitigate the negative somatic outcomes associated with their job than their counterparts who do not suffer from these somatic symptoms (cf., Fay & Sonnentag, 2002). Alternatively, it may be the opposite: that these individuals would be less successful in pursuing proactive behaviors to change their jobs because the adverse somatic outcomes such as obesity and related diseases negatively affect their mental energy and capacity needed to effectively pursue proactive behaviors. We clearly need more research that focuses on multiple criteria of somatic and behavioral outcomes in the area of job

design to enhance our understanding of the complex effect of job characteristics on individual reactions (e.g., Johns, 2010).

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