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Testing the Vitamin Model of job stress in Dutch health care workers

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Three central hypotheses of Warr's Vitamin Model concerning the relationship between job characteristics and well-being and health outcomes were tested: (1) differential effects of job characteristics on the various well-being and health outcomes; (2) predominance of curvilinear associations; and (3) moderate influence of negative and positive affectivity on these relationships. The study participants were 162 employees from a health care organization (aged 19–54 years, 95% women) who completed questionnaires on job demands and job autonomy, as well as on the outcome variables depression, anxiety, job satisfaction, and health complaints. In addition, data on short-term sickness absence were collected. A higher level of job demands was significantly associated with a lower level of well-being and self-reported health. Job autonomy showed weaker relationships with the outcome variables. The effects of job demands were still large after controlling for negative and positive affectivity, while the effects of job autonomy in most cases became non-significant. The predicted curvilinear relationship between job characteristics and outcome variables did not have an additional value over a linear model in predicting the data. It is concluded that the present data from a homogeneous sample of mostly female nurses support Warr's Vitamin Model to a limited extent.

1. Introduction

The relation between job characteristics and employee well-being and health has been the subject of many studies. Many of the empirical studies on this issue have been inspired and guided by the Job-Demand-Control Model developed by Robert Karasek (1979). The original model postulated the significance of two specific job features in their effect on individual health and well-being: job demands and decision latitude. The former is defined as 'the psychological stressors involved in accomplishing the work load' (Karasek, 1979). It refers to matters such as time-pressure, high working pace and complex work. Decision latitude is defined as the potential control of working individuals over their tasks combined with their skill usage. Warr (1987a, 1987b, 1990a, 1990b, 1994, 1996) developed a conceptual framework that can be perceived as a reaction and an addition to the Karasek model. In his so-called Vitamin Model, Warr uses the way vitamins affect human health as a metaphor for the effect of environmental influences on mental health and well-being (Warr, 1987a). Although his framework applies to any given environment, attention is

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specifically drawn to the working situation. With his Vitamin Model, Warr claims to be more exhaustive than the other approaches. Central features of Warr's Vitamin Model are his comprehensive description of the mental health concept, the curvilinear relations between job characteristics and mental health, the differential effects of specific job characteristics and the influence of person characteristics. These central features will be discussed briefly below.

Within his description of mental health, affective well-being is the most central issue, consisting of two dimensions within the affective space defined by the orthogonal dimensions pleasure and arousal: comfort vs. anxiety and enthusiasm vs. depression. Warr (1990a, 1996) developed reliable scales for the measurement of the job-related comfort-anxiety and enthusiasm-depression dimensions. A central theme is Warr's assumption that different job characteristics are associated with these dimensions in different ways. For instance, job demands are supposed to be more strongly associated with the comfort-anxiety dimension while job autonomy would be more closely related with enthusiasm-depression. Differential associations have indeed been found in earlier studies examining the Vitamin Model (Warr, 1990a; De Jonge, Mulder, and Nijhuis, 1999; De Jonge, and Schaufeli, 1998).

Another central element of the Vitamin Model is the assumption of a curvilinear relation between the job characteristics and well-being and other mental health outcomes. As mentioned before, Warr (1987a) draws a parallel with the physiological effect of vitamin intake; at first vitamin consumption causes positive health effects, but beyond a certain level there is no further improvement, or even decrement. Most job characteristics, including job demands and decision latitude are claimed to show beneficial effects up to a certain point beyond which the effect indeed becomes detrimental. In other words, for most job characteristics there is an optimal level, while at both ends of the distribution the effects on well-being and health are hypothesized to be unfavourable. The few studies until now examining curvilinear relationships between job characteristics and health have provided some evidence for non-linear associations (De Jonge, and Schaufeli, 1998; Warr, 1990b), but not consistently (De Jonge, Reuvers, Houtman, Bongers, and Kompier, 2000). These discrepancies are at least partly due to methodological differences between the studies, such as the participant samples and outcome variables used.

The final central feature of the Vitamin Model that will be discussed here briefly concerns individual differences between people. Although the model framework in general can be mainly characterized as situation centred, which means that explanations are primarily sought in aspects outside the individual, there is attention to the fact that person characteristics might act as mediating factors in the studied relationships (Warr, 1987a, 1987b). Warr demonstrated the influence of person characteristics mainly through the effect of two major personality traits: 'negative affectivity' (NA) and 'positive affectivity' (PA), first introduced by Watson, and Clark (1984). NA and PA can be defined as affective dispositions, which reflect differences in emotional style and feelings about oneself (Warr, 1996). Trait NA is a dimension that reflects a stable and pervasive tendency towards negative mood and negative self-concept (Watson, and Clark, 1984) while trait PA reflects the extent to which a person feels enthusiastic, active and alert (Watson, Clark, and Tellegen, 1988). Although the terms NA and PA might suggest that they are opposite mood factors, this is not the case. Scores on measures of the two dispositions are only moderately correlated with each other (Warr, 1996).

Measuring person characteristics in studies of job stress is particularly important because most research in this area is based on self-reports of both stress and health variables. Observed relationships between stressors and strains may therefore to a certain extent result from individual differences in cognitive-affective appraisal. It has been found that observed

relationships between stressor and strain measures were inflated considerably by NA (Brief, Burke, George, Robinson, and Webster, 1988). Although the presumed influence of person characteristics was less evident in some studies (Chen, and Spector, 1991; Jex, and Spector, 1996; Levin, and Stokes, 1989; Spector, 1987), it has been demonstrated in several other studies (Watson, and Pennebaker, 1989; Schaubroeck, Ganster, and Fox, 1992). Therefore, in the present investigation, we have examined the influence of the person characteristics NA and PA and, if necessary, controlled for it statistically.

Owing to the potential importance of the Vitamin Model for both theory and applications in the work environment and in light of the few (and sometimes inconsistent) studies conducted on this theme so far, the main aim of the present study was to test the three central aspects of the Vitamin Model discussed above. In particular, the investigation addressed the effects of job demands and autonomy on well-being and mental health, while controlling for the potential effects of NA and PA. The choice of job demands and autonomy arise from their prominence in several job stress theories, besides the fact that they are repeatedly brought up in social debate on labour and mental health (Hackman, and Oldham, 1980; Karasek, 1979). The specific hypotheses were the following.

- (1) *Hypothesis 1.* Job demands will have a main effect on job-related anxiety while job autonomy will have a main effect on job-related depression.
- (2) *Hypothesis 2.* Controlling for trait NA and trait PA in the regression of self-reported strain on self-reported stressors will reduce the stressor-strain relationship, but will not eliminate the effect of the job characteristics.
- (3) *Hypothesis 3.* Job demands and job autonomy will be non-linearly associated with the different aspects of mental health. The initial positive effects on psychological health will diminish and eventually change into a negative effect, as reflected by a quadratic relationship.

2. Method

2.1. Participants

Three hundred randomly selected health care workers from one Dutch organization were asked to complete questionnaires on 'work stress'. Complete data were provided by 162 persons (54% of those approached). Some 95% of the respondents were women. The respondent's age varied between 19 and 54 years ($M = 36.5$ years, $SD = 8.4$ years).

2.2. Measures

2.2.1. Job autonomy: Job autonomy was measured by the Maastricht Autonomy Questionnaire (MAQ; De Jonge, Landeweerd, and Van Breukelen, 1994). The MAQ consists of 10 items, which measure the amount of self-determination of the worker over a variety of task aspects (working methods, time management, etc.). The 5-point response scale varies from 1 = very little influence to 5 = very much influence. The reliability (Cronbach's α of .86) and validity of the MAQ have been confirmed in several studies, including studies that demonstrated a substantial association with the autonomy-scale from the Job Content Questionnaire (De Jonge *et al.*, 1994; Karasek, 1985) and studies that showed predicted relationships with well-being variables (De Jonge *et al.*, 1994; De Jonge, Janssen, and Van Breukelen, 1996; De Jonge, and Schaufeli, 1998).

2.2.2. *Job demands*: Job demands were assessed by an 8-item questionnaire and can be defined as the extent to which psychological stressors are present in the working environment. Quantitative aspects such as time pressure are included as well as qualitative aspects (job complexity, exhausting work, etc.). This scale with a 5-point response format has been developed by De Jonge, Landeweerd, and Nijhuis (1993). The scale has good internal consistency (Cronbach's α of .90) and validity (De Jonge *et al.*, 1993, 1996, 1999).

2.2.3. *Positive and negative affectivity*: Positive and negative affectivity were measured by means of the PANAS scale (Watson *et al.*, 1988). This scale consists of 22 items, which reflect a person's state of mind. Using a 5-point response scale, individuals point out whether these items generally reflect their feelings. In earlier research (Watson *et al.*, 1988), Cronbach's α coefficients of .86 (NA) and .80 (PA) were found.

2.2.4. *Job satisfaction*: The assessment of job satisfaction took place by the use of a single item Likert scale: 'I am satisfied with my present job'. Scores on a 5-point scale vary between 'fully agree' and 'totally disagree'. Earlier research has revealed that the validity and reliability of rating job global satisfaction with only one question is equally good as the use of a multi-faceted scale on job satisfaction (Scarpello, and Campbell, 1983; Weaver, 1980).

2.2.5. *Job-related anxiety and depression*: Job-related anxiety and depression were measured by means of two, 6-item questionnaires developed by Warr (1990a) and specifically designed to examine these axes. Items are preceded by: 'Thinking of the past weeks, how much of the time has your job made you feel ...'. Responses vary on a 6-point scale between 'never' and 'all of the time'. The construct validity and reliability of the scales have been confirmed in different studies (Sevastos *et al.*, 1992; Warr, 1990a, 1990b) with Cronbach's α coefficients between .76 and .85.

2.2.6. *Experienced health*: Self-perceived health symptoms were assessed by the Dutch Questionnaire for the Research on Experienced Health (VOEG; Dirken, 1967). The scale consists of 21 dichotomous items (yes/no) and these relate to various recently experienced somatic complaints, such as headache, heart complaints, feelings of low energy, etc. Cronbach's α is .83 (De Jonge *et al.*, 1996).

2.2.7. *Sickness absence*: The frequency of short duration (< 8 days) absence due to an illness during the past year was obtained from the personnel department of the employer, after having received written permission from the respondents to use these data.

2.3. Data analyses

All hypotheses were tested by means of hierarchical multiple regression analyses (SPSS for Windows, version 7.0, SPSS Inc, Chicago, IL). In every analysis the effects of age and gender were controlled for by entering them at the first step in the regression model. The inclusion of education was not necessary, since almost all participants had the same educational background.

For testing Hypothesis 1 (differential effects), the variables job demands and autonomy were entered into the regression model after entering the control variables (age and gender). The same procedure was applied for testing Hypothesis 2, with the difference that the variables NA and PA were brought into the regression model before the job characteristics

variables. When testing Hypothesis 3, the following steps were entered into the model: (1) control variables; (2) the linear terms of job demands and autonomy; and finally (3) the non-linear (quadratic) terms of job demands and autonomy. Subsequently, Model 2 (control variables and linear terms) was compared with Model 3 (control variables, linear terms, and quadratic terms) in order to determine whether the non-linear terms have a significant contribution in the prediction of the outcome variables. Comparison of the models took place through calculating the incremental *F*-test (Aiken, and West, 1991).

3. Results

Besides descriptive statistics for the stressors, strains and dispositional measures, simple Pearson correlations between all these variables are presented in table 1.

Gender did not correlate with any variable, while age was negatively related to autonomy and sickness absence ($r = -.17$, $p < .05$ and $r = -.18$, $p < .05$, respectively). Sickness absence was not related to any other variable, while the other dependent measures were significantly interrelated ($r > .30$, $p < .01$). Job demands and autonomy were negatively interrelated ($r = -.30$, $p < .01$) while both job characteristics correlated with all dependent measures except absence due to illness.

3.1. Differential effects

In table 2, the results of the regression analyses regarding the differential main linear effects are presented. There was a significant association between both job demands and autonomy on the one hand and anxiety on the other. The influence of job demands ($\beta = .58$, $p < .001$) was much stronger than the influence of autonomy ($\beta = -.15$, $p < .05$). This finding supports the hypothesis that job demands are more strongly related to anxiety than autonomy. Nonetheless, with regard to the outcome variables depression and satisfaction, job demands also showed the most important relationship ($\beta = .48$, $p < .001$ and $\beta = -.44$, $p < .001$, respectively). The regression coefficients for autonomy were much smaller, in the case of depression they were not even significant ($\beta = -.12$, $p > .10$ and $\beta = .14$, $p < .05$, respectively). In contrast, the effect of autonomy on experienced health ($\beta = .26$, $p < .001$) was slightly larger than the effect of job demands ($\beta = -.23$, $p < .01$). Sickness absence only showed a significant relationship with age, not with the job characteristics.

3.2. Person characteristics

The regression analysis in which the NA and PA traits were entered before the job characteristics showed predictive power of these traits with respect to all outcome variables, except sickness absence (table 3). However, with regard to anxiety, depression, and satisfaction, the largest proportion of the variance remained explained by job demands ($\beta = .57$, $\beta = .50$, and $\beta = -.45$, respectively, $p < .001$). However, this was not the case regarding autonomy. The regression coefficients of autonomy dropped below significance in all three cases after NA and PA were entered into the regression model. For experienced health, the strongest predictor was NA ($\beta = -.32$, $p < .001$), which, however, did not change the coefficients of autonomy ($\beta = .21$, $p < .01$) and job demands ($\beta = -.20$, $p < .01$) substantially. Again, sickness absence did not show any association with the predicting variables, except with age ($\beta = -.18$, $p < .05$).

Table 1. Means, standard deviations, internal consistencies and intercorrelations.

	M	SD	α	2	3	4	5	6	7	8	9	10	11
1. Gender	—	—	—	.06	.07	.02	.01	.04	-.05	.07	-.06	.01	-.15
2. Age	36.5	8.4	—	—	.05	-.17*	.02	.03	.08	.06	.13	.10	-.18*
3. Job demands	3.32	0.64	.90	—	—	-.30**	.04	.15	-.49**	.62**	.52**	-.31**	.03
4. Autonomy	2.64	0.60	.87	—	—	—	.20*	-.15	.28**	-.32**	-.27**	.33**	.03
5. Positive affectivity	3.56	0.45	.80	—	—	—	—	-.37**	.21**	-.19*	-.36**	.20*	.03
6. Negative affectivity	1.64	0.57	.86	—	—	—	—	—	-.27**	.33**	.33**	-.39**	-.11
7. Satisfaction	3.90	1.04	—	—	—	—	—	—	—	-.47**	-.56**	.33**	.04
8. Anxiety	3.00	0.80	.84	—	—	—	—	—	—	—	.65**	-.45**	-.01
9. Depression	2.20	0.72	.85	—	—	—	—	—	—	—	—	-.40**	-.04
10. Experienced health	1.75	0.20	.85	—	—	—	—	—	—	—	—	—	-.01
11. Sickness absence	1.22	1.42	—	—	—	—	—	—	—	—	—	—	—

* $p < .05$; ** $p < .01$.

Table 2. Standardized β 's of the predicting variables for each outcome variable.

Predictor	Anxiety	Outcome variables		Experienced health	Sickness absence
		Depression	Satisfaction		
Age	< .10	< .10	< .10	< .10	− .18*
Job demands	.58***	.48***	− .44***	.23**	< .10
Autonomy	− .15*	− .12	.14*	.26***	< .10
R^2					
Total model	.41	.28	.25	.16	.03

* $p < .05$; ** $p < .01$; *** $p < .001$.

Table 3. Standardized β 's of the predicting variables for each outcome variable, including negative and positive affectivity.

	Anxiety	Depression	Satisfaction	Experienced health	Sickness absence
Age	< .10	< .10	< .10	< .10	− .18*
Negative affectivity	.19**	.13*	− .13	− .32***	< .10
Positive affectivity	− .13*	− .32***	.17*	< .10	< .10
Job demands	.57***	.50***	− .45***	− .20**	< .10
Autonomy	< .10	< .10	< .10	.21**	< .10
R^2					
Total model	.47	.43	.31	.26	.04

* $p < .05$; ** $p < .01$; *** $p < .001$.

3.3. Curvilinear relationship

The existence of curvilinear relationships has been examined by building subsequent regression models that contained the variables gender and age (Model 1), gender, age, and the linear terms of job demands and autonomy (Model 2), and finally gender, age, and both the linear and quadratic terms of job demands and autonomy (Model 3). Table 4 shows the amount of explained variance (R^2) for each model. The linear model (Model 2) explained a great deal of the variance of the outcome variables (except for sickness absence). The proportion of additional variance that is explained by the model containing the quadratic terms is non-significant (incremental $F(6, 154) < 2.36, p \geq .10$).

4. Discussion

In the present study, some of the crucial predictions from Warr's Vitamin Model were tested in a group of health care workers. When examining the results, one has to conclude that only partial support was obtained for two of the three hypotheses, while no support was found for curvilinear relationships between job characteristics and well-being and health.

With regard to the first hypothesis, the results demonstrate only to some extent the presence of differential effects of the task characteristics on well-being and health. All three well-being measures (depression, anxiety, and satisfaction) showed a strong relationship with job demands, while the association with autonomy was much lower, in the case of depression not even reaching significance. This is inconsistent with the prediction of the Vitamin Model, according to which autonomy should have the principal effect on feelings

Table 4. Amount of explained variance (R^2) of the linear and non-linear models in relation to the different outcome variables.

Model	Outcome variables			Experienced health	Sickness absence
	Anxiety	Depression	Satisfaction		
1. Age and gender	.01	.02	.01	.01	.05
2. 1+ Job demands and Autonomy	.41	.30	.26	.17	.05
3. 2+ Job demands ² and Autonomy ²	.41	.31	.28	.19	.08
Incremental F (model 3 vs. model 2)	.05 ($p > .10$)	1.28 ($p > .10$)	2.35 ($p = .10$)	1.16 ($p > .10$)	2.06 ($p > .10$)

of depression. The results were somewhat different only with respect to experienced health, showing equally strong associations for both job demands and autonomy.

Potential methodological explanations for this failure to find unequivocal support for the first hypothesis were examined. Perhaps the relatively weak associations found for autonomy might have been due to a restriction of range as a result of small sample variance in the autonomy scores. This, however, is not the case. As can be seen in table 1, the overall means of job demands and autonomy are almost equally distant from the scales' mid-points, and there is no substantial difference between the standard deviations of the scales. Another possible explanation involves the sample's homogeneity. Warr's analyses (1990b) finding the differential effects were based on a sample of 1686 male and female respondents employed in a variety of jobs from various occupational levels. Also the study by De Jonge, and Schaufeli (1998) had a somewhat more heterogeneous sample than our investigation, which included health care workers from one institute, of which 95% were female. As Warr points out, it is likely that some job features have a lower impact on well-being in a group of individuals with specific 'non-matching characteristics' (Warr, 1994). For instance, one might speculate that the present study's homogeneous group of mainly nurses may have a relatively low need for autonomy, resulting in weaker negative effects of low job autonomy on well-being and health. De Jonge *et al.* (1996), studying a similar health care workers sample, also failed to find a direct effect of autonomy on a depression-related measure (emotional exhaustion). One must also take into consideration the possibility that the predicted differential effects are not as distinct in all contexts as the theory assumes, even more so if we consider the strong bivariate correlation between feelings of depression and feelings of anxiety (.65).

Another notable finding in the study of differential effects is that neither job demands nor autonomy showed a significant association with (short duration) sickness absence. Although one may have expected a more powerful relationship than that found in this study, the present result is consistent with earlier findings (Spector, and Jex, 1991). The empirical basis for the proposition that job characteristics have an important impact on short-duration sickness absence is therefore not very strong (Van Veldhoven, 1996).

The second hypothesis addressed the influence of personality traits on an individual's levels of well-being. The assumption that job demands and autonomy are more strongly related to well-being and health variables than person characteristics such as NA and PA is partly confirmed in this study. Job demands remained as the major predictor of well-being, when controlled for NA and PA. On the other hand the opposite was the case for autonomy. After partialling out NA and PA influences, autonomy was not a significant

predictor of the well-being variables. One of the conclusions that can be drawn is that both job demands and negative and positive affectivity are relatively independently related to well-being, although the effects of job demands are considerably stronger. With regard to experienced health, however, NA appears to be the strongest predicting variable. This result is consistent with the Symptom Perception Hypothesis developed by Watson, and Pennebaker (1989), which predicts that high-NA individuals are more sensitive to (insignificant) physical problems and bodily sensations and for that reason report more health complaints.

The prediction of the existence of a non-linear relationship between job characteristics and well-being variables is not supported by the data in this study. Job demands and autonomy were strongly associated with feelings of depression, anxiety and satisfaction in a linear way, but an (inverted) U-shape relationship that would explain additional variance could not be identified. Therefore, this study provides no support for the postulation that job demands and autonomy follow a pattern similar to the influence of vitamins A and D on individuals' health. The present data are not consistent with some previous research, which found curvilinear associations between job characteristics and well-being variables (De Jonge, and Schaufeli, 1998; Van Veldhoven, 1996; Warr, 1990b). A possible explanation for the predominance of linear associations in this study may be the distribution of the job characteristics scores using a homogeneous sample of nurses. Warr assumes that there is a kind of plateau in the middle of the distribution, indicating that, at a moderate level, differences in job characteristics levels are less important in relation to a person's well-being than differences at both ends of the distribution (Warr, 1987a, 1987b). In addition, if the data include scores belonging to one end of the distribution of a job characteristic, but very few scores at the other end, the appearance of a curvilinear relationship is not likely, since in this case the data can be adequately reflected by a linear relationship. For instance, if only middle and high scores of job demands predominate, a negative linear relationship will be likely to appear (decreasing feelings of well-being associated with increasing levels of job demands). In order to examine this possible explanation, the distributions of the job characteristics were more closely observed. Regarding autonomy, there were practically no very high scores. On the 5-point Likert scale, with 3 being the mid-point, the highest score was 4, while only 5% of the respondents had a mean score above 3.5. In contrast, 47% of the cases scored below 2.5. It seems that in the present sample mainly the left side of a potential curvilinear relationship may have been studied, which may explain the positive linear relationship found between job autonomy and well-being and health. For job demands, the opposite seems to be the case. Only 3% of the sample report low levels of job demand (scores below or equal to 2 on the 5-item scale), while 15% report high levels (scores above or equal to 4). This indicates that the sample's distribution tends towards higher levels of job demands, which is most properly characterized by the right end of the theoretical inverted U-shape. Again, this possible explanation may, at least partially, account for the negative linear relationship found between job demands and well-being and the absence of a curvilinear one.

Alternatively, the theoretical general curvilinear relationship between many job characteristics and well-being and health may need further refinement. For instance, one cannot exclude the possibility that job demands are particularly detrimental in cases of high levels (in contrast to low levels), while the negative effects of autonomy on the other hand are more likely to be strongest in low doses, resulting in differently skewed inverted U shapes. Depending on how weak the effects are at the flatter end of the distribution in a particular population and context, sometimes a curvilinear relationship and sometimes a linear association will fit the data better.

The major conclusion that can be drawn from this study is that it does not provide unequivocal support for the different aspects of the Vitamin Model. A number of theoretical and methodological explanations have been proposed for this finding. The fundamental question remains, whether in most contexts the relationship between job characteristics and well-being and health is accurately explained by means of the vitamin metaphor. In the present study, the strongest effects that were found were the linear negative effects of job demands on well-being and self-reported health. In future studies, a comprehensive investigation of the Vitamin Model, including a variety of job features, person characteristics, and work settings, may lead to a better understanding of the complex relationship between these factors and health and well-being.

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