Article

Predicting Cardiovascular Disease from Psychosocial Safety Climate: A Prospective Cohort Study from Australia

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Abstract: Cardiovascular Disease (CVD) is the most prevalent disease worldwide, which has been linked to work stress because of poor job design as explained by the Job Demand-Control (JDC) and the Effort-Reward Imbalance (ERI) models. In this paper we explore for the first time relative impact of a specific aspect of organisational climate, Psychosocial Safety Climate (PSC), on any CVD including angina, myocardial infarction, hypertension, and stroke. We used two waves of interview data from Australia, with an average lag of 5 years (excluding baseline CVD, final n = 1223). Logistic regression was conducted to estimate the prospective associations between PSC at baseline on incident CVD at follow-up. It was found that participants in low PSC environments were 59% more likely to develop new CVD than those in high PSC environments. Logistic regression showed that PSC at baseline predicts lower CVD risk at follow-up (OR = 0.98, 95% CI 0.96-1.00), and this risk remained unchanged even after joint adjustment for measures of ERI and JDC. These results suggest that PSC is an independent risk factor for CVD in Australia. Beyond job design this study implicates organisational climate and prevailing management values regarding worker psychological health as the genesis of CVD.

Keywords: Cardiovascular Disease; Psychosocial Safety Climate; Demand-Control; Effort-Reward Imbalance; Psychosocial Risks

1. Introduction

Cardiovascular Disease (CVD), a group of disorders of the heart and blood vessels that manifest in acute events such as heart attack and stroke (as defined by the World Health Organisation, 2017), is the greatest health risk in the world (Lozano et al., 2013). Notably, CVD causes more deaths than any other single cause accounting for approximating 30% of deaths annually worldwide (Schnall, Dobson, & Landsbergis, 2016). Among working age populations 10%-20% of all causes of CVD deaths are work related (Tsutsumi, 2015). Despite some major improvements in cardiovascular health via public health interventions, CVD continues to grow as a global pandemic. This widespread health impact has a correspondingly large impact on workplace productivity; CVD has been classified as the single greatest cause of workplace productivity loss in the world (Perk et al., 2012; Piepoli et al., 2016). In addition to commonly-known CVD risk factors such as smoking and obesity (Perk et al., 2012), work-related psychosocial risk factors and job stress have been established

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as predictors of CVD (Chandola et al., 2008; Fishta & Backé, 2015; Li, Dollard, Loerbroks, & Angerer, 2015; Piepoli et al., 2016; Schnall, Dobson, & Landsbergis, 2016; Steptoe & Kivimäki, 2012).

Most CVD studies have focused on job design frameworks such as the Job Demand-Control (Karasek, 1979), or the Effort-Reward Imbalance model (Siegrist, 1996) to explain work stress related CVD. These models have focused on proximal work-related psychosocial risk factors (i.e., job design characteristics that are harmful to health), yet the root cause may be more contextual and relate to features of the organisational climate that potentially shape these harmful job characteristics. Focusing on the "causes of the causes" has been identified as a key focus for future research (Schnall, Dobson, & Landbergis, 2016). In this research we contextualise CVD as a work related health problem that not only relates to job design, but may be predicted by organisational factors further upstream. We use Psychosocial Safety Climate (PCS, i.e., the organisational climate for worker psychological health) theory to frame the study. Under PSC theory working conditions are determined by the prevailing management values concerning worker psychological health. To date there is much evidence linking PSC to work conditions and health outcomes (Bailey, Dollard, McLinton, & Richards, 2015; Bailey, Dollard, & Richards, 2015; Dollard & Bakker, 2010; Law, Dollard, Tuckey, & Dormann, 2011) but no studies have explored the link between this specific aspect of organisational climate and CVD.

The aim of this study is to determine whether PSC is a predictor of future employee CVD, and which theory (PSC, Effort-Reward Imbalance and Job Demand-Control) provides a better account of risk of future CVD.

1.1. Work Stress Theories and CVD

Job stress in this paper refers to adverse health reactions to taxing work conditions. To understand how work-related psychosocial factors influence the risk of CVD, studies have typically used well-evidenced work stress models. Effort-Reward Imbalance theory posits the primary cause of job stress and related health effects is an imbalance between excessive efforts and insufficient rewards (Siegrist, 1996; Van Vegchel, De Jonge, Bosma, & Schaufeli, 2005). In the Effort-Reward Imbalance theoretical framework, 'efforts' are work-related demands that an employer requires of their employees (e.g., work tasks, responsibilities), and 'rewards' are the benefits that employers bestow upon their employees (e.g., money, job security, esteem). The Job Demand-Control theory (Karasek, 1979) posits that the health of workers is determined by the level of job demands they experience, in combination with levels of control, such as decision authority and skill discretion. Under Job Demand-Control theory job strain refers to those jobs that combine high levels of demands with low levels of control and give rise to adverse health consequences.

The potential increased risk of CVD associated with job stress has been examined using the Effort-Reward Imbalance and Job Demand-Control models across a range of studies and populations (Piepoli et al., 2016). While the Effort-Reward Imbalance model does not explicitly link high effort or low rewards with adverse long term effects on cardiovascular health, an increased risk of CVD is consistent with the core assumptions of the Effort-Reward Imbalance model (Kivimäki & Siegrist, 2016). Given that an imbalance of efforts and rewards is associated with increased job stress (de Jonge, Bosma, Peter, & Siegrist, 2000), and job stress is associated with CVD (Dimsdale, 2008), it is logical that effort-reward imbalance would be indicative of increased risk of CVD. A similar logic can be applied to Job Demand-Control theory; high demands and low control lead to work stress and stress is associated with CVD.

Evidence shows that effort-reward imbalance is linked to CVD. An 11-year longitudinal analysis of the Whitehall II data revealed that those in high effort-reward imbalance jobs are 26% more likely to develop coronary heart disease than their peers (Kuper, Singh-Manoux, Siegrist, & Marmot, 2002). A 24-year longitudinal analysis of Finnish workers, revealed that workers with high effort-reward imbalance were 140% more likely to develop CVD than their peers (Kivimäki et al., 2002). Effort-reward imbalance has been recently confirmed as an important increased risk factor for CVD, using large pooled data from 11 European cohort studies (RR = 1.16; Dagano et al., 2016), over and above established risks such as long working hours (Relative Risk [RR] = 1.39; Virtanen et al.,

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2012), and job insecurity (RR = 2.00; Vahtera et al., 2004). The overall burden of this increased risk is considerable.

There is also a strong literature linking Job Demand-Control job strain (i.e., high job demands and low control) to CVD, across major demographics and over time (Kivimäki, Batty, Ferrie, & Kawachi, 2014; Kivimäki et al., 2012; Schnall, Dobson, & Landsbergis, 2016) to non-fatal myocardial infarction and death from CVD, where, after adjustment for sex and age, the hazard ratio for job strain versus no job strain was 1·23, with the effect higher in published (HR = 1.43) than unpublished (HR = 1.16) studies (Kivimäki et al., 2012). Job strain is also associated with an increased risk of ischemic stroke, (Fransson et al., 2015), and research has found support for both job strain and effort-reward imbalance as independent risk factors for stroke (Jood, Karlsson, et al., 2017).

Some of the literature examining the relationship between psychosocial work conditions and CVD has focused on how prolonged stressful work conditions may induce CVD such as hypertension (Ming et al., 2004; Vrijkotte, Van Doornen, & De Geus, 2000). Workers experiencing chronic work stress have increased blood pressure (Schnall et al., 1998), even when they are not at work (Vrijkotte et al., 2000). The mechanism for this effect is thought to be a combination of hyper-reactivity of the sympathetic nervous system, along with reduced vagal tone – a symptom of reduced activity of the parasympathetic nervous system (Vrijkotte et al., 2000). A systematic review found support for the effects of both Job Demand-Control and Effort-Reward Imbalance Models on blood pressure level and hypertension in approximately half of the studies reviewed (Gilbert-Ouimet, Trudel, Brisson, Milot, & Vézina, 2014).

While the Effort-Reward Imbalance and Job Demand-Control models are well-adapted to identifying the sources and levels of job stress and the creation of task-related interventions (Bourbonnais, Brisson, Vinet, Vezina, & Lower, 2006; Li et al., 2017), they are less well suited to identifying the organisational-level characteristics which precede effort-reward imbalance and Job Demand-Control and its associated health outcomes (Owen, Bailey, & Dollard, 2016). An important goal of organisational psychosocial interventions is to create sustainable change beyond the short term reduction of job stress, so that hazardous psychosocial work conditions are modified so that associated job stress does not return upon cessation of the intervention (Swerissen & Crisp, 2004). The limitation of focusing on Effort-Reward Imbalance and Job Demand-Control models is that they do not address a potential origin of the problem, Psychosocial Safety Climate.

1.2. Psychosocial Safety Climate Theory

Psychosocial Safety Climate refers to perceptions about "organisational policies, practices and procedures for the protection of worker psychological health and safety" (Dollard & Bakker, 2010, p. 580). PSC is largely determined by management values and practices, and organisational systems that enable communication and participation, in prevention, identification and resolution of work stress related issues. In high PSC contexts managers are concerned for worker health and wellbeing, and design jobs that have manageable demands and adequate resources (Dollard & Bakker, 2010; Dollard et al., 2009; Law, Dollard, Tuckey, & Dormann, 2011). Low PSC workplaces are characterised by senior management values, for example, that prioritise short-term productivity over the psychological health of employees; jobs may be designed with unmanageable psychological and emotional demands (Bailey, Dollard, McLinton, & Richards, 2015). Since PSC predicts the way jobs are designed, it is theoretically a precursor to the job design stress theories, and has been shown empirically to predict effort-reward imbalance (Owen et al., 2016) and Job Demand–Control job strain (Dollard, Opie et al., 2012).

Psychosocial Safety Climate has been shown to predict psychological health outcomes such as depression (Becher & Dollard, 2016; McTernan, Dollard, & LaMontagne, 2013), psychological distress (Becher & Dollard, 2016; Law et al., 2011), and emotional exhaustion (Law et al., 2011). Yet, CVD has not yet been investigated as an outcome of PSC. There is limited evidence available to demonstrate the predictive power of PSC on physical health in a longitudinal sample. Longitudinal designs are better suited to teasing out causal effects. The current study addresses a gap in the literature by examining the link between PSC and future CVD over a subsequent four to six years

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after initial measurement. Since PSC can negatively predict a range of risk factors for work stress, including those embodied in Effort-Reward Imbalance and Job Demand-Control theories we propose a hypothesis that PSC negatively predicts future CVD over and above effects due to effort-reward imbalance, and Job Demand-Control job strain.

2. Materials and Methods

2.1. Participants

Participants were interviewed using Computer Assisted Telephone Interviewing as part of the Australian Workplace Barometer (AWB) project, a national surveillance project of psychosocial risks in Australian workplaces. We used a subsample of the wider AWB study, including participants with data at two times points on average 5 years apart, excluding, self-employed and missing data on health outcome measures.

The final sample comprised 1223 participants who were free from any CVD at Time 1, 545 (44.6%) males and 678 (55.4%) females, aged between 18 and 73 (median = 47 years) at Time 1. Their education status was diverse with 35.8% holding a bachelor degree or higher, 29.4% with a certificate or diploma, 8% trade/apprenticeship, 17.7% left school after age of 16, 9.1% left school at 16 years or less. The median annual income was 50 to 60 thousand AUD. The participants were located in three different Australian states: South Australia (n = 428), Western Australia (n = 439), and New South Wales (n = 356). Time 1 data collection was conducted in 2009 in NSW and WA, and 2010 in SA. Time 2 data was collected in 2014-15 across all three states. All subjects gave their informed consent for inclusion before they participated in the study. The study protocol was approved by the University of South Australia Human Research Ethics Committee (approved 17th June 2009).

2.2. Measures

Information was collected on participant's age, gender, socioeconomic status and education level, which were all included as covariates in all analyses as in other CVD research (e.g., Nyberg, Heikkila, Fransson, *et al.*, 2012).

Psychosocial Safety Climate was measured using the PSC-12, a 12-item questionnaire consisting of the four sub-scales each of which have three items (Hall, Dollard, & Coward, 2010). The subscales and example items are; management commitment, e.g., "In my workplace senior management acts quickly to correct problems/issues that affect employees' psychological health"; management priority, e.g., "Senior management considers employee psychological health to be as important as productivity"; organisational participation, e.g., "Employees are encouraged to become involved in psychological health and safety matters", and organisational communication, e.g., "There is good communication here about psychological safety issues which effect me". Responses are scored on a 5-point Likert scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Since the subscales are highly correlated for practical purposes we added all the scales together to form a global measure, $\alpha = .94$. Psychosocial Safety Climate benchmarks used in this study, developed by Bailey and colleagues (2015), were PSC low (≤ 37), moderate (37.01 - 40.99), and high (≥ 41). We used these benchmarks to create three levels of PSC.

Cardiovascular disease was measured using questions from the World Health Organization Health and Work Performance Questionnaire (Kessler et al., 2003). Participants were asked whether "in the past two years have you consulted a health professional with regard to chest pain, or any other cardiovascular related health problem – such as myocardial infarction; angina; stroke; or hypertension?", and if so, what diagnosis was returned, and the four disease categories were listed. CVD was dummy coded as 1 (*cardiovascular disease diagnosed*) or 0 (*no doctor visit or no cardiovascular disease diagnosed*). We ruled out "other" diagnoses mentioned such as heart murmur, stress, blood clot, no problem.

Effort-reward imbalance was measured using the ratio of effort to reward. For convenience, extrinsic effort was measured using five items from the psychological demands subscale of the Job Content Questionnaire (JCQ, Karasek et al., 1998), with responses on a four-point Likert scale with

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responses ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). Higher scores represent a greater amount of perceived effort by the worker, α = .68. Rewards were measured based on 4 items from the Effort-Reward Imbalance Scale (Siegrist, 1996) with 1 item from the esteem reward component: "Considering all my efforts and achievements, I receive the respect and prestige I deserve at work"; 2 items from the job promotion reward component an example being, "Considering all my efforts and achievements, my job prospects are adequate"; and 1 item from the job security reward component, "My job security is poor". The items were measured on a four-point Likert scale, ranging from 1 (*strongly disagree*) to 4 (*strongly agree*) as recommended (Montano, Li, & Siegrist, 2016). Higher scores represent a greater amount of perceived organizational rewards received by the worker, α = .68.

Effort-reward imbalance was calculated using the ratio method as recommended by Effort-Reward Imbalance theorists and this formulation has construct validity (Siegrist et al., 2004). The formula for this calculation is $\frac{\text{Effort}}{\text{Rewards}*1.25}$. The correction factor of 1.25 accounts for the unequal amount of items between the Efforts (demands) and Rewards measures. At Time 1, there were 426 (34.8%; before removal of baseline CVD, 36.3%) in high effort-low reward jobs (ERI > 1).

Job Demand-Control job strain was assessed using combinations of job demands and control. Job demands was the same measure as 'effort' described above, assessed with the five item psychological demands subscale of the JCQ (Karasek et al., 1998), with responses on a 4-point Likert scale with responses ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). Higher scores represent a greater amount of perceived demand by the worker, α = .68. Job control was assessed from the Job Content Questionnaire (Karasek et al., 1998, www.jcqcenter.org) subscales, skill discretion (six items, e.g., My job requires a high level of skill; alpha = .75) and decision authority (three items, e.g., "My job allows me to make decisions on my own"; alpha = .73). Responses are on a 4-point Likert scale from 1 (*strongly disagree*) to 4 (*strongly agree*).

There are several statistical variations used in the literature to calculate job strain. We used the quartile-based job strain as recommended by Choi, Ko, & Östergren (2015) and Karasek, Choi, Ostergren, Ferrario, & De Smet, (2007) because of their greater sensitivities than the median-based job strain definition with no significant changes in specificities. The methods result in a five-category version of the Job Demand-Control model leading to five distinct groups – low strain, high strain, passive work, active work, and midpopulation. The Job Demand-Control job strain measure used here assigned 1 (*high strain*), and 0 (*other groups*), and three other dummy variables were entered in the models simultaneously (e.g. 1 (*active work*) and 0 (*other groups*) and so on). In the high strain group, there were 192 (15.7%; before removal of baseline CVD, 15.9%). For interest, using a different approach and dichotomising demands and control (scales equally weighted) at the median yielded n = 191 (15.6%; before removal of baseline CVD, 15.8%) in high strain groups at Time 1 respectively.

2.3. Statistical Analyses

We used SPSS software for all analyses. For hypothesis testing since the outcome measure was binary we used binary logistic regression. After removing baseline cases of CVD (n = 97) we regressed Time 2 CVD on the demographic covariates (Model 1), and entered the work environment measures separately (Model 2, 3, 4), and then simultaneously (Model 5).

3. Results

3.1. Correlations between Measures

As shown in Table 1, of the demographic variables (age, gender, education, income) only age was significantly associated with CVD at Time 2. Of the work measures, PSC was significantly negatively related to CVD at Time 2.

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Table 1. Intercorrelations between study variables.

	1	2	3	4	5	6	7
1. Age T1							
2. Gender T1	0.03						
3. Education T1	-0.04	0.05					
4. Income T1	0.17***	-0.43***	0.27***				
5. Job Strain T1	-0.01	0.09***	-0.04*	-0.05			
6. Effort-Reward Imbalance T1	0.00	0.10***	0.11***	0.05	0.37***		
7. Psychosocial Safety Climate T1	-0.00	0.02	-0.04	-0.04*	-0.35***	-0.25***	
8. CVD T2	0.11***	0.00	-0.07	0.02	-0.00	0.02	-0.06*

Note. ***, $p < .001$; **, $p < .01$; *, $p < .05$. T, Time. n = 1223.

3.2 Incidence Rate of CVD

Over the 5 year period, 98 new CVD cases occurred among 1223 participants who were free from any CVD at Time 1 (cumulative incidence rate = 8%). We conducted some preliminary incidence tests of CVD by PSC benchmarks. Comparisons between low, moderate, and high PSC environments demonstrate that those in high PSC environments exhibited lower rates of overall CVD after an approximate five year time lag (see Table 2). Participants in low and moderate PSC environments were more likely (59% and 45% more, respectively) to develop CVD than those in high PSC environments. The sensitivity analyses, using different levels of PSC, demonstrated a higher level of CVD in participants working in low PSC (high risk) work environments.

Table 1. PSC benchmarks and CVD incidence.

PSC Time 1	Number of participants	Participants with CVD at Time 2	% with CVD at Time 2	Average higher incidence
Low	365	41	11.23%	59%
Moderate	97	10	10.30%	45%
High	663	47	7.08%	

Note. Low PSC ≤ 37; Moderate PSC 37.01 - 40.99; High PSC ≥ 41. N = 1223 (history of CVD removed).

As shown in Table 3, Model 1, the demographics age and education at Time 1 were related to CVD at Time 2. Controlling only for the significant demographics age and education, as shown in Model 2, job strain, and Model 3, effort-reward imbalance, were not significantly associated with future CVD; as shown in Model 4, PSC was significantly related to future CVD. Our hypothesis that PSC predicts future CVD over and above effects due to job design factors (effort-reward imbalance, and Job Demand-Control job strain) was supported.

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Table 3. Predicting Cardiovascular Disease at Time 2.

		B	S.E.	Wald	Sig.	Odds Ratio	Low CI	High CI
Model 1	Constant	-4.30	0.74	33.31	0.00	0.01	0.00	0.06
	Age Time 1	0.04	0.01	18.62	0.00	1.05	1.02	1.06
	Gender Time 1	0.07	0.22	0.11	0.74	1.08	0.70	1.65
	Education Time 1	-0.13	0.06	5.25	0.02	0.88	0.78	0.99
	Income Time 1	0.08	0.05	2.45	0.12	1.09	0.98	1.19
Model 2	JCQ Job Strain Time 1#	0.09	0.40	0.06	0.81	1.10	0.50	2.40
Model 3	Effort-Reward Imbalance Time 1	0.50	0.38	1.71	0.19	1.65	0.78	3.47
Model 4	Psychosocial Safety Climate Time 1	-0.02	0.01	4.22	0.04	0.98	0.96	1.00
Model 5	Constant	-3.08	0.98	9.81	0.00	0.05	0.01	0.31
	Age Time 1	0.04	0.01	12.99	0.00	1.04	1.02	1.06
	Education Time 1	-0.13	0.06	4.84	0.03	0.87	0.78	0.99
	Effort-Reward Imbalance Time 1	0.51	0.47	1.18	0.28	1.66	0.66	4.18
	JCQ Job Strain Time 1	-0.47	0.45	1.08	0.30	0.62	0.26	1.51
	Psychosocial Safety Climate Time 1	-0.02	0.01	4.34	0.04	0.98	0.96	1.00

Note. # Job strain was always entered with 3 other dummy variables. ^, an alternative measure of job strain, with standardised demand and control measures dichotomised at the mean to form 4 categories, high demand, high control = 1, else = 0 also yielded non significant effects, as did the multiplicative interaction term. PSC was entered as a continuous measure as was effort-reward ratio.

4. Discussion

Studies which have neglected to assess PSC may have underestimated the effect of the work environment on CVD. This research expands previous research that has linked task related psychosocial work conditions to CVD (e.g. Li et al., 2015) by including a more distal organisational level factor, that is PSC. The aim of this research was to explore the relationship between PSC and CVD, compared to more traditional psychosocial risk factors: effort-reward imbalance and Job Demand-Control job strain. We also explored the relationship between PSC and CVD before and after adjustment for effort-reward imbalance ratio and Job Demand-Control job strain. We used a two-wave longitudinal sample to demonstrate the causal nature of the effect of organisational and psychosocial work conditions on CVD in workers. Furthermore, an average 5 year gap between the first and the final rounds of data collection allowed us the opportunity to examine the longer term effect of psychosocial risks on a chronic and ongoing health problem (i.e., CVD). This is an important contribution to the literature, as many studies either only present a cross-sectional correlation (Peter et al., 1998), providing no evidence of causation, or include time lags as short as one year (van Amelsvoort, Schouten, & Kok, 2004) which is insufficient to measure the onset of many chronic diseases.

Logistic regression showed that PSC is significantly negatively related to higher CVD risk (OR = 0.98, 95% CI 0.96-1.00). This risk remained, after additional adjustment for job strain and ERI measures. Work job design factors, effort-reward imbalance and job strain were not significant contributors to future CVD.

The research demonstrates that a climate for psychological health and safety predicts future cardiovascular disease. Workers who believe that their employers are not prioritising their mental health are more likely to experience cardiovascular disease over the next five years. The results are somewhat at odds with much previous research showing the detrimental effect of Job Demand-Control job strain and effort-reward imbalance on CVD; for instance in relation to Dragano

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et al.'s (2016) multi-cohort finding, our sample size was much smaller (cf., 90, 164) and the prediction time span was smaller (cf., 9.8 years).

4.1. Practical Implications

Psychosocial Safety Climate is a reflection of the priorities and practices of senior management within an organisation, and therefore presents an ideal intervention point for those seeking to address the workplace psychosocial factors relating to CVD.

In the UK alone, a 1% reduction in CVD risk is estimated to prevent 25,000 CVD cases per year and save €40 million per year (Collins et al., 2014). Assuming similar PSC rates to Australia, if workers in low and moderate PSC workplaces had their CVD incidence reduced to that of workers in high PSC workplaces, this would represent a 40% decrease in CVD risk, or approximately €4 billion per year in UK terms. Workplace interventions to improve PSC could potentially reduce CVD risk substantially, saving billions of dollars in developed countries around the world.

This study provides policy makers with additional evidence of the harm caused by psychosocial risks in the workplace. Given the substantial body of evidence demonstrating the important role that job characteristics in the aetiology of CVD, and the evidence the PSC precedes work conditions shown elsewhere, and the link between PSC and CVD shown here, there is a drastic need for organizational intervention research to determine whether psychosocial risk prevention reduces CVD in workers, potentially saving lives, improving wellbeing, and increasing productivity. Policy makers should consider psychosocial risk management as an additional tool in the public health campaigns aimed at reducing CVD. Businesses that wish to improve organisational health should consider a PSC intervention to reduce CVD onset in workers.

4.2. Limitations

One reason that we did not observe correlations between ERI and JD-C job strain may have been that those with high levels left the sample. Compared to our very initial sample of 3030, the proportion of employees in high strain jobs was 21% whereas in our matched sample over 5 years it was around 16%. Our results may be at variance with other studies, due to measures used, length of time lag (5 years), and the general working population sample. Our study analysed PSC at the individual level, despite its conceptualisation as an organisational level construct. This is a limitation of the population-based sampling technique used in the AWB project. Population-based sampling provided a representative sample of Australian workers from all major industries, occupations, and demographic groups. However, it also provides fewer organisations with sufficient group sizes for multilevel analysis (Scherbaum & Ferreter, 2009). Given that CVD only occurred in a small proportion of the population, and the population-based sampling technique used, analysing PSC at the organisational-level would have reduced the power of the analysis too severely. As such, the likelihood of a Type II error would be too high, so an individual-level analysis of PSC was used. It is possible that the assumption of independence of the data used was violated, as approximately 20% of the participants belonged to the same organisation. We justified analysis at the individual-level based on previous research demonstrating that PSC has some individual-level properties separate from organizational level influences (Bailey et al., 2015; Dollard & Bakker, 2010). Another limitation goes to the measurement of CVD. In our study, the incident cases of CVD were based on self-reports. Though register data (such as hospitalization records) are generally preferred, it has been shown that self-reported CVD have reasonable sensitivity and specificity, with acceptable agreement to medically certified records (Okura et al., 2004).

5. Conclusions

This longitudinal research, in Australia, showed that cardiovascular problems newly diagnosed by a doctor, could be best predicted over a five year time period by PSC. Understanding the association between an organisation's PSC and the CVD risk borne by its workers may allow for

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organisational level interventions to reduce CVD risk and inform policy makers on potential legislative requirements for CVD reduction measures through PSC.

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Dedication: In honor of Harry Becher, his sharp mind, and his passion for better work conditions.

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