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Work stress, overcommitment personality and alcohol consumption based on the Effort–Reward Imbalance model: A population–based cohort study

Sung-Wei Chen [a,*], Hynek Pikhart [b], Anne Peasey [b], Andrzej Pajak [c], Ruzena Kubinova [d], Sofia Malyutina [e], Martin Bobak [b]

[a] Department of General Psychiatry, Taoyuan Psychiatric Center, Ministry of Health and Welfare, Taoyuan, Taiwan
[b] Research Department of Epidemiology and Public Health, University College London (UCL), United Kingdom
[c] Institute of Public Health, Faculty of Health Sciences, Jagiellonian University Medical College, Krakow, Poland
[d] Center for Environmental Health Monitoring, National Institute of Public Health, Prague, Czech Republic
[e] Research Institute of Internal and Preventive Medicine, Institute of Cytology and Genetics, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia

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ABSTRACT

Work stress has been extensively supported to predict health outcomes like health behaviors. Evidence has linked work stress and personality independently to health, but the interrelationships between work stress and personality and their joint effects on health might deserve more attention in research. This study attempts to integrate recent developments in psychological research (diverse roles of personality in stress processes) into the well–established Effort–Reward Imbalance (ERI) model for work stress. Based on the ERI model, this population–based cohort study aims to investigate the relationships between work stress, personality and alcohol consumption; it particularly focuses on potential roles of overcommitment (OC) personality in ERI–drinking relations, including modifying, antecedent, mediator or direct effects. This two–wave cohort study was conducted in population samples of 3782 men and 3731 women (aged 45–69 years) from Czech Republic, Poland and Russia. Alcohol consumption was assessed by three drinking outcomes: binge drinking, heavy drinking and problem drinking. To assess modifying effect of OC in ERI–drinking relations, logistic regression was used. To assess antecedent or mediator role of OC in ERI–drinking relations, path analysis with the autoregressive and cross–lagged model was conducted. The results showed that OC had no significantly modifying effect in ERI–-drinking relations. OC and ERI might have bidirectional relationships in the average follow–up period of 3.5 years; the effect of OC on ERI was remarkably stronger than the reversed causation. Antecedent role of OC in ERI–drinking relationship was significant, but mediator role of OC was not. In conclusion, our findings imply that "antecedent role" of OC in ERI–drinking relations is significant and promising as a potential target for individual intervention; future interventions are suggested to identify and target potential cognitive–behavioral mechanisms via which personality might influence work stress and subsequently health behaviors.

1. Introduction

Work stress has become a global challenge for public health in a drastically changing society characterized by rapid technological changes and globalized economies. Work stress defined by the Demand–Control model (Karasek, 1979) and the Effort–Reward Imbalance (ERI) model (Siegrist, 1996) has been extensively supported to predict a wide range of health outcomes: cardiovascular diseases (Dragano et al., 2017), depression (Rugulies et al., 2017), and health behaviors like alcohol consumption (Head et al., 2004; Heikkilä et al., 2012) and diet (Chen et al., 2016). In addition, personality has been recognized to predict various health outcomes such as chronic diseases and mortality (Graham et al., 2017; Smith & MacKenzie, 2006). Evidence has linked work stress and personality independently to health, but the interrelationships between work stress and personality and their joint effects on health remain less clear and thereby deserve more

Abbreviations: ERI, Effort–Reward Imbalance; OC, Overcommitment.

* Corresponding author. Department of General Psychiatry, Taoyuan Psychiatric Center, Ministry of Health and Welfare, No.71, Longshou St, Taoyuan City, 33058, Taiwan.

E-mail addresses: epidemucl33@gmail.com (S.-W. Chen), h.pikhart@ucl.ac.uk (H. Pikhart), a.peasey@ucl.ac.uk (A. Peasey), mmpajak@cyf-kr.edu.pl (A. Pajak), kubinova@szu.cz (R. Kubinova), smalyutina@hotmail.com (S. Malyutina), m.bobak@ucl.ac.uk (M. Bobak).

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attention in scientific research.

In previous studies, a personality variable was often controlled as a confounder (a source of self–report bias) in work stress–health relations (Stansfeld, 2002). Before researchers can reasonably remove the effect of a suggested confounder, more concern about the existence and nature of mechanisms linking a confounder and the variables of interest is needed (Spector & Brannick, 2011). If indeed personality has a substantive role in work stress–health relations, statistical control for it may remove that substantive effect. Spector et al. (2000) proposed potentially substantive mechanisms via which personality might affect work stress and health: antecedent (personality affects work stress that influences health), mediator (work stress affects personality that influences health) and modifying effect (interaction between personality and work stress). Until now, their concepts of various roles of personality still inspire empirical research (Christensen et al., 2019).

Based on current psychology and life–course perspectives in epidemiology and psychiatry, potentially diverse roles of personality in work stress–health relations appear theoretically plausible (Newton-Howes et al., 2015). There has been increased recognition for bidirectional relationships between personality and social environment (e.g., work stressors) across life span. Social environments in childhood and adulthood might shape an individual's personality; personality might influence an individual's proneness to stressor exposure (creation, selection and perception) and reactivity to environmental stressors (Caspi et al., 2005; Semmer, 2006).

In a meta-analysis of 250 studies, Luo et al. (2022) recognized that the magnitude and direction of the relations between personality traits and stress were inconsistent across studies; personality traits (e.g., neuroticism) may play important roles in stressor exposure and psychological stress response. The associations between personality and stress displayed different patterns when stressors in different life domains (e.g., work stressors, life or interpersonal stressors) were examined. A longitudinal design assessing personality and stress at different time points can provide better evidence. Parkes (2010) reviewed 33 longitudinal studies on the relations between work stress, personality and health; only 6 studies had sample sizes larger than 5000. Personality might play significant roles (antecedent, mediator, modifying or direct effects) in work stress–health relations, but findings across studies were inconsistent; different personality variables may act through different mechanisms.

It is premature to draw a firm conclusion about the roles of personality in work stress–health relations, as the results have been inconsistent across different studies that vary in measurements and contexts. Therefore, a large–sample longitudinal study focusing on specific constructs of work stress and personality is still needed to establish sequential and ultimately causal nature of potential roles of personality in work stress–health relations.

This study attempts to integrate recent developments in psychological research (diverse roles of personality in stress processes) into the well–established ERI model for work stress. In the ERI model, work stress is defined by the violation of social reciprocity in terms of high extrinsic effort (heavy workload, interruption, responsibility, overtime, physical demands and increasing demands) and low reward (salary, esteem, promotion prospect and job security). In this study, the reasons for focusing on this model are twofold. First, the ERI model proposed a personality variable – overcommitment (OC), which was hypothesized to have main effect or modifying effect in ERI–health relations (Siegrist et al., 2004). We suggest that the breadth of the ERI model might be enriched by evaluating other potential roles of OC. Second, evidence has already supported the impacts of ERIon alcohol consumption (Bobak et al., 2005; Head et al., 2004) and the effects of OC–related personality on alcohol consumption, respectively (Adan et al., 2017; Connor-Smith & Flachsbart, 2007). Thus, it appears reasonable to use ERI work stress, OC personality and alcohol consumption (health behavior) to investigate potential roles of personality in work stress–health relations.

The aim of this population–based cohort study (7513 subjects) is to examine the relations between ERI, OC and alcohol consumption in population samples from Czech Republic, Poland and Russia, particularly focusing on potential roles of OC personality in ERI–drinking relations, including modifying, antecedent, mediator or direct effects.

The study populations were from Central and Eastern Europe (CEE, the countries in Baltics, Central Europe, Eastern Europe and Southeast Europe, usually meaning former communist states) and Former Soviet Union (FSU, the sovereign states that were republics of the Soviet Union before 1991). In CEE/FSU, the socioeconomic transition from centrally planned to market economies was accompanied by drastically changing working conditions. Among European countries, the levels of job insecurity were highest in Poland, Czech Republic and Hungary (László et al., 2010). Work stress was found to predict cardiovascular diseases (Kopp et al., 2006), poor health (Salavecz et al., 2010), depression (Pikhart et al., 2004) and alcohol consumption (Bobak et al., 2005) in CEE/FSU. This context of social transformation might provide a natural setting to examine the interplay between work stress, personality and health. The background of this study is extended in the next section.

2. Theory and evidence

2.1. Overcommitment as a personality construct

The ERI model incorporated a personality construct – overcommitment (OC). OC reflects a "cognitive–motivational pattern" of coping with demands characterized by high need for control, high need for approval, excessive striving at work, and inability to withdraw from work; high OC persons tend to maintain excessive effort under inadequate reward (Siegrist et al., 2004). A conceptually similar construct is "workaholism" – being overly concerned about work, to be driven by strong and uncontrollable work motivation, and to spend so much energy and effort into work that it impairs relationships, leisure and health (Andreassen et al., 2018).

"Personality" is a dynamic organization of psychophysical systems that creates a person's characteristic patterns of thoughts, feelings and behaviors; this definition is an attempt to integrate diverse perspectives in psychology, including dispositional (trait), learning (social–cognitive) or cognitive perspectives (Carver & Scheier, 2016). In contrast to the broader and more static description in trait approaches, social–cognitive constructs provide a more active and specific process account of individual differences (cognitive, emotional or behavioral process). OC should be considered a social–cognitive construct, which generally includes mental representation, motive, cognitive appraisal, or coping strategy (Smith & MacKenzie, 2006).

OC was initially described as "need for control", a work–related reformulation derived from Type A behavior, characterized by hostility, time urgency, competitiveness, hard driving, and high need for control over environment (Siegrist et al., 1990). Hostility (an element in Type A behavior) was found to correlate strongly with neuroticism ($r = 0.63–0.66$) (Felsten, 1996). Neuroticism is the individual difference in the tendency to experience negative emotional states. Probably due to the above links, OC was reported to correlate significantly with Type A behavior ($r = 0.39$) and neuroticism ($r = 0.30–0.38$) (Allisey et al., 2012; Vearing & Mak, 2007).

OC–related personality constructs (Type A behavior and neuroticism) have been repeatedly reported to predict alcohol consumption (Adan et al., 2017; Connor-Smith & Flachsbart, 2007). Personality traits increase the risk of alcohol use via two mechanisms: behavioral disinhibition and negative emotionality; high neuroticism persons tend to experience negative emotions (sadness, worry or anger) under stress, thereby using alcohol drinking to alleviate psychological distress (Hicks et al., 2012).

2.2. Main or modifying effect of personality in work stress–health relation

The arguments and empirical studies on potential roles of OC–related

personality (neuroticism and Type A behavior) in work stress–health relations are reviewed. The ERI model's original hypotheses on OC are formulated as follows: (1) Main effect: a high level of OC resulting in continued exaggerated effort and disappointing reward can directly increase the risk of poor health. (2) Modifying effect: a modifying effect implies that the magnitude and direction of the effect of ERI on an outcome depends on the level of OC. High OC individuals might react more strongly to the same level of ERI and experience more adverse health effects of ERI than low OC counterparts.

In Siegrist and Li's (2016) review, main effects of OC on health outcomes were supported in 78% of 27 studies, but modifying effects of OC in ERI–health relations were found significant in only 38% of 21 studies.

2.3. Antecedent or mediator role of personality in work stress–health relation

Antecedent role of OC (OC influences ERI that subsequently affects outcomes) is probable based on theory and evidence. Personality might influence work stress via theoretically plausible mechanisms: (1) Perception: personality influences subjective perception to objective work stressors; high neuroticism individuals tend to perceive their jobs as having high levels of stressors. (2) Stressor creation: high neuroticism individuals may create objective work stressors for themselves by provoking interpersonal conflicts or poor work performance. (3) Selection: Type A persons may select themselves into highly competitive jobs, as they tend to set task goals higher than abilities, leading to failure and distress (Semmer, 2006; Spector et al., 2000). In empirical evidence, Type A behavior and neuroticism measured at adolescence predicted ERI and job strain at adulthood in cohort studies (Hintsa et al., 2010; Hintsanen et al., 2011).

Despite not explicitly claiming it, Siegrist has implied the possibility of antecedent role of OC in ERI–outcome relations. His quotations are cited: "This motivational style affects how demands are appraised. Perceptual distortion prevents OC people from accurately assessing cost–gain relations. As a consequence, they underestimate the demands and overestimate their own coping resources while not being aware of their own contribution to nonreciprocal exchange" (Siegrist, 2008). "They may expose themselves more often to high demands at work, or they exaggerate their efforts beyond what is formally needed" (Siegrist et al., 2004).

Mediator role of OC (ERI influences OC that then affects outcomes) appears possible based on theory and evidence. Classical trait perspective suggesting that personality does not change over time was challenged. In a meta–analysis of 152 longitudinal studies, test–retest correlations of personality trait increased from 0.31 in childhood to 0.64 at age 30, and reached at 0.74 between age 50 and 70; personality continues to change throughout adulthood but only modestly after age 50 (Roberts & DelVecchio, 2000). A meta–analysis of 207 studies found that clinical interventions may result in marked changes in personality traits (Roberts et al., 2017).

Several cohort studies reported that psychosocial factors at work can predict subsequent changes of personality constructs like neuroticism (Bleidorn et al., 2018; Wu et al., 2020). Notably, antecedent and mediator roles may coexist; several cohort studies have reported bidirectional relationships between personality and work experience across life span (Roberts et al., 2003; Scollon & Diener, 2006; Sutin et al., 2009).

3. Material and methods

3.1. Study population and sample

This population–based cohort study used the data from the Health, Alcohol and Psychosocial factors In Eastern Europe (HAPIEE) study, a multicentre prospective cohort study of urban populations in Czech Republic (six towns), Poland (Krakow) and Russia (Novosibirsk). After stratification by gender and 5-year age group, men and women aged 45–69 years were randomly selected from the population registers (Czech Republic and Poland) and the electoral list (Russia) using a computerised procedure; selected individuals were invited to participate in the study. Participants were assessed twice, between 2002 and 2005 (wave 1) and between 2006 and 2008 (wave 2). All procedures involving human subjects were approved by the ethical committees in our universities in United Kingdom and all three countries. Each participant completed a written informed consent, a structured questionnaire and a medical examination (Peasey et al., 2006).

In 28947 participants recruited at baseline, 13271 eligible subjects were employed and answered a questionnaire module on work characteristics including the ERI model, but others (e.g., retired or unemployed) did not. Then, those with missing values in exposures, outcomes or covariates at wave 1 (1150) were excluded. Next, those lost to follow–up at wave 2 (3450) and with missing values in exposures or outcomes at wave 2 (1158) were excluded. The analytical sample with complete information on exposures and outcomes at both waves and on covariates at wave 1 consisted of 7513 subjects (3782 men and 3731 women). The demographic data of the total sample in men and women will be shown in Table 1.

3.2. Outcomes of alcohol consumption

Alcohol consumption in the last 12 months was evaluated by the graduated frequency questionnaire (GFQ) (Gmel & Rehm, 2004). This questionnaire contained 9 categories of frequency (almost every day, 3–4/week, 1–2/week, 2–3/month, 1/month, 6–11/year, 3–5/year, 1–2/year, and never) and 6 categories of amounts of ethanol consumed per single occasion (≥10, 7–9, 5–6, 3–4, 1–2, and 0.5 local units). One local unit represented 0.5 L of beer, 0.2 L of wine, and 0.05 L of spirits; 100 ml of beer, wine and spirit was assumed to contain 4, 10 and 36 g of ethanol, respectively.

Three drinking outcomes were derived based on information from GFQ: (1) Binge drinking: a dichotomous variable was defined by drinking at least 100g in men or 60g in women of ethanol per drinking session at least once a week. (2) Heavy drinking: a dichotomous variable was defined by drinking >350 g/week of ethanol in men or > 210 g/week of ethanol in women. (3) Problem drinking: the CAGE questionnaire contains four items with two responses (0 = no; 1 = yes). With a cutoff point of 2, sensitivity ranged from 0.78 to 0.81 and specificity ranged from 0.76 to 0.96 in relation to alcohol dependence (Rush et al., 2008).

The validity and reliability of these drinking measures were assessed in the HAPIEE study. The GFQ–based drinking outcomes were strongly associated with other measures: serum biomarkers, weekly alcohol intake and alcohol intake in the last 3 months from the food frequency questionnaire administered separately (Bobak et al., 2016). Internal consistency was assessed by correlations of different measures and by repeating the measurements after six months (Bobak et al., 2005).

3.3. Work stress and personality construct

The ERI model is operationalized as a standardized self–reported measure containing 23 items, defining three dimensional scales: extrinsic effort, reward, and OC. Extrinsic effort is measured by 6 items on demanding aspects of work environment: quantitative load, qualitative load, physical load, and increasing load. Reward is assessed by 11 items on financial reward, esteem reward, promotion prospect and job security (Siegrist et al., 2004). The extent of imbalance between extrinsic effort and reward is measured by effort–reward (ER) ratio; extrinsic effort score is put in numerator, and reward score in denominator is multiplied by a correction factor (6/11) adjusting for unequal number of items.

OC (intrinsic effort) is assessed by 6 items, each with answers on a

Table 1
Descriptive statistics of the study sample by country and gender (N = 7513).

	Czech		Russia		Poland		Total	
Variables Number (%)	Men N = 1082	Women N = 1099	Men N = 1402	Women N = 1394	Men N = 1298	Women N = 1238	Men N = 3782	Women N = 3731
Covariates, wave 1								
Age: 45–49	279 (26)	372 (34)	300 (21)	408 (29)	357 (28)	461 (37)	936 (25)	1241 (33)
50–54	306 (28)	422 (38)	353 (25)	453 (32)	380 (29)	423 (34)	1039 (27)	1298 (35)
55–59	313 (29)	202 (18)	387 (28)	314 (23)	317 (24)	230 (19)	1017 (27)	746 (20)
60–69	184 (17)	103 (9)	362 (26)	219 (16)	244 (19)	124 (10)	790 (21)	446 (12)
Education:								
University	279 (26)	193 (18)	533 (38)	491 (35)	601 (46)	532 (43)	1413 (37)	1216 (33)
Secondary	382 (35)	547 (50)	464 (33)	395 (28)	396 (31)	517 (42)	1242 (33)	1459 (39)
Vocational	391 (36)	277 (25)	324 (23)	454 (33)	256 (20)	141 (11)	971 (26)	872 (23)
Primary/less	30 (3)	82 (7)	81 (6)	54 (4)	45 (3)	48 (4)	156 (4)	184 (5)
Occupation:								
Manual	326 (30)	186 (17)	531 (38)	275 (20)	254 (20)	170 (14)	1112 (29)	631 (17)
Non–manual worker	461 (43)	727 (66)	479 (34)	843 (60)	650 (50)	845 (68)	1590 (42)	2415 (65)
Manager/profession	295 (27)	186 (17)	391 (28)	276 (20)	393 (30)	223 (18)	1080 (29)	685 (18)
Marital status:								
Single	30 (3)	31 (3)	35 (3)	85 (6)	43 (3)	104 (8)	108 (3)	220 (6)
Married/cohabiting	926 (86)	790 (72)	1279 (91)	885 (64)	1188 (92)	875 (71)	3393 (90)	2550 (68)
Divorced/widowed	126 (12)	278 (25)	88 (6)	424 (30)	67 (5)	259 (21)	281 (7)	961 (26)
Deprivation:								
Low (<4)	946 (87)	909 (83)	1011 (72)	740 (53)	1057 (81)	929 (75)	3014 (80)	2578 (69)
High (4–9)	136 (13)	190 (17)	391 (28)	654 (47)	241 (19)	309 (25)	768 (20)	1153 (31)
Depression:								
No	974 (90)	885 (81)	1214 (87)	1013 (73)	1118 (86)	935 (76)	3306 (87)	2833 (76)
Yes (CESD ≥16)	108 (10)	214 (19)	188 (13)	381 (27)	180 (14)	303 (24)	476 (13)	898 (24)
Social isolation:								
No	699 (65)	789 (72)	632 (45)	655 (47)	597 (46)	614 (50)	1928 (51)	2058 (55)
Yes	383 (35)	310 (28)	770 (55)	739 (53)	701 (54)	624 (50)	1854 (49)	1673 (45)
Self–rated health:								
Very good – average	1019 (94)	1045 (95)	1290 (92)	1147 (82)	1220 (94)	1165 (94)	3529 (93)	3357 (90)
Poor – very poor	63 (6)	54 (5)	112 (8)	247 (18)	78 (6)	73 (6)	253 (7)	374 (10)
Outcomes, wave 1								
Binge drinking								
No	1001 (93)	1045 (95)	1202 (86)	1343 (96)	1245 (96)	1198 (97)	3448 (91)	3586 (96)
Yes	81 (7)	54 (5)	200 (14)	51 (4)	53 (4)	40 (3)	334 (9)	145 (4)
Heavy drinking								
No	845 (78)	963 (88)	859 (61)	1167 (84)	1080 (83)	1114 (90)	2784 (74)	3244 (87)
Yes	237 (222)	136 (12)	543 (39)	227 (16)	218 (17)	124 (10)	998 (26)	487 (13)
Problem drinking								
No	964 (89)	1054 (96)	1141 (81)	1343 (96)	1167 (90)	1200 (97)	3272 (87)	3597 (96)
Yes	118 (11)	45 (4)	261 (19)	51 (4)	131 (10)	38 (3)	510 (13)	134 (4)
Outcomes, wave 2								
Binge drinking								
No	984 (91)	1050 (96)	1207 (86)	1335 (96)	1215 (94)	1192 (96)	3406 (90)	3577 (96)
Yes	98 (9)	49 (4)	195 (14)	59 (4)	83 (6)	46 (4)	376 (10)	154 (4)
Heavy drinking								
No	776 (72)	921 (84)	889 (63)	1107 (79)	997 (77)	1055 (85)	2662 (70)	3083 (83)
Yes	306 (28)	178 (16)	513 (37)	287 (21)	301 (23)	183 (15)	1120 (30)	648 (17)
Problem drinking								
No	987 (91)	1052 (96)	1133 (81)	1336 (96)	1145 (88)	1191 (96)	3265 (86)	3579 (96)
Yes	95 (9)	47 (4)	269 (19)	58 (4)	153 (12)	47 (4)	517 (14)	152 (4)

4–point scale: (1) I get easily overwhelmed by time pressures at work. (2) As soon as I get up in the morning, I start thinking about work problems. (3) When I get home, I can easily relax and switch off work. (4) People close to me say I sacrifice too much for my job. (5) Work is still on my mind when I go to bed. (6) If I postpone something that I was supposed to do today, I have trouble sleeping at night. The OC score is created by summing them up.

The ERI questionnaire was translated into all three languages and back-translated to confirm accuracy of original translations; the validity and reliability of this instrument were found acceptable in the HAPIEE study (Pikhart et al., 2004). For internal consistency, Cronbach's alpha of extrinsic effort, intrinsic effort and reward in this study were 0.69, 0.71 and 0.74, respectively.

3.4. Covariates

The subjects were aged 45–69 years old at baseline and stratified by 5-year age groups. Due to small proportion of working respondents in 65–69 age group, it was incorporated into 60–69 age group. Marital status, education level, and occupational grade were categorized. Material deprivation was calculated as the sum of responses to three questions, covering the frequency of not having all the food, clothing, electricity and heating needed. As the responses were on a 4–point scale, their sum was between 0 and 9 (Bobak et al., 2000).

Depressive symptoms were measured by Center for Epidemiologic Studies Depression (CESD) scale consisting of 20 self–reported items. The cutoff value of ≥16 has been widely used to define clinically meaningful depressive symptoms (Radloff, 1977). Social isolation was measured by regular contact with friend or relative less than once a

month. Self–rated health was assessed by a standard question with answers on a 5–point scale (1 = very good; 5 = very poor) (Ware & Sherbourne, 1992).

3.5. Statistical analysis

Descriptive characteristics in the sample were analyzed by country and by gender. Most of crude associations between exposures and drinking outcomes were different across gender–specific strata ($p < 0.1$) but not statistically different across country–specific strata, so data for three countries were pooled for further analyses.

The associations between ER ratio at wave 1 and three drinking outcomes at wave 2 were assessed by three logistic regression analyses, respectively, after adjusting for covariates at wave 1. The OC–drinking associations were examined in a similar way.

To evaluate modifying effects of OC in ERI–drinking relations, logistic regression was conducted for each drinking outcome by OC, ERI, and ERI–OC interaction term after adjusting for covariates. By comparing log likelihoods for the model with ERI–OC interaction term and the model without, likelihood–ratio test was used to test the significance of this interaction term. All above analyses were conducted by statistical software Stata 11 (StataCorp, 2009).

3.6. Path analysis with the autoregressive and cross–lagged model

To assess antecedent or mediator role of OC in ERI–drinking relations, three path analyses for each drinking outcome were conducted, respectively, using software Mplus 7.1 (Muthén & Muthén, 2012). Nonlinear relationships between continuous variables and dichotomous outcomes were linked by the probit model. Mplus software uses probit regression to estimate thresholds for categorical outcomes and provides more complicated iterative approaches based on probit distribution. For non–normal distribution of dichotomous outcomes, mean– and variance–adjusted weighted least squares (WLSMV) estimator was used to choose parameter values (MacKinnon, 2008).

Path analysis with the autoregressive and cross–lagged model was specified for each drinking outcome (Fig. 1). First, in terms of autoregressive, each variable was predicted by the same variable at an early wave (Path a, b and c). Second, the cross–lagged effects of OC at wave 1 on ERI at wave 2 (Path e) and ERI at wave 1 on OC at wave 2 (Path g) were measured to identify the directionality of causal relations between OC and ERI. Taris and Kompier's (2006) approach was adopted in this 2–wave cohort study, using the product of two cross–lagged path coefficients to estimate the mediator effect. The mediator role of ERI in OC–drinking relation was assessed by two cross–lagged effects: OC at wave 1 on ERI at wave 2 (Path e); ERI at wave 1 on drinking at wave 2 (Path f). The mediator role of OC in ERI–drinking relation was estimated by two cross–lagged effects: ERI at wave 1 on OC at wave 2 (Path g); OC at wave 1 on drinking at wave 2 (Path d).

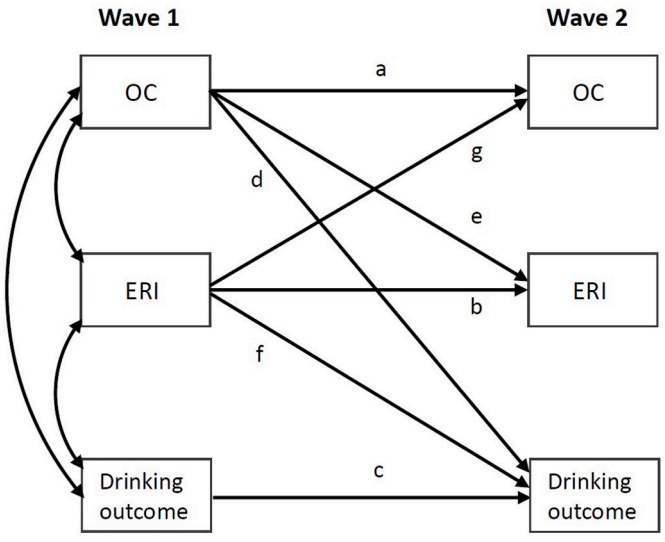

Fig. 1. Path analysis with the autoregressive and cross–lagged model is specified for each drinking outcome in this 2–wave study; each letter is used to represent a path.

Standardized path coefficients were used to compare the relative magnitude of change associated with different paths in the same model; standardized coefficient reflects the expected standard deviation change in the outcome with one standard deviation change in the predictor. The bootstrap method with 5000 samples was adopted for significance testing of mediator effect due to categorical outcomes. As no clear guideline for goodness-of-fit evaluation exists for categorical data (Xia & Yang, 2019), conventional cutoff criteria were used to indicate good model fit as follows: Root Mean Square Error of Approximation (RMSEA) < 0.06, Comparative Fit Index (CFI) > 0.95, and Tucker–Lewis Index (TLI) > 0.95 (Hu & Bentler, 1999).

4. Results

In this study sample of 3782 men and 3731 women, the means of age at wave 1 are 54.8 years (standard deviation, SD = 6.0) in men and 53.2 years (SD = 5.4) in women. The average follow–up periods between wave 1 and wave 2 are 3.5 years (SD = 0.7) in men and 3.6 years (SD = 0.6) in women. Descriptive statistics of this study sample by country and by gender are presented in Table 1.

4.1. Modifying effect of overcommitment

Table 2 shows the associations between ER ratio at wave 1 and three drinking outcomes at wave 2 by three logistic regression analyses, respectively. In terms of modifying effects of OC in ERI–drinking relations, likelihood–ratio tests are used to compare the model with OC–ERI interaction term and the model without; the interaction terms are not significant for binge drinking in men ($p = 0.853$) and women ($p = 0.851$), for problem drinking in men ($p = 0.196$) and women ($p = 0.312$), and for heavy drinking in men ($p = 0.362$) and women ($p = 0.932$).

4.2. Antecedent or mediator role of overcommitment

Table 3 shows the results of three path analyses for antecedent or mediator role of OC in the relations between ERI and three drinking outcomes, respectively. In the path analysis for binge drinking, men are taken for example. First, the mediator effect of ERI in OC–drinking relation is estimated by multiplying 2 cross–lagged effects: (1) higher OC at wave 1 significantly associated with higher ERI at wave 2 (standardized path coefficient b = 0.146); (2) higher ERI at wave 1 significantly associated with binge drinking at wave 2 (b = 0.143). This mediator effect of ERI is significant (b = 0.021, $p < 0.001$). Second, the mediator effect of OC in ERI–drinking relation is estimated by multiplying 2 cross–lagged effects: (1) higher ERI at wave 1 significantly associated with higher OC at wave 2 (b = 0.079); (2) higher OC at wave 1 associated with binge drinking at wave 2 (b = 0.058, p = 0.054). This mediator effect of OC is not significant (b = 0.005, p = 0.077). In fit indices, RMSEA is 0.055 indicating good model fit, CFI is 0.861 showing acceptable fit, and TLI is 0.786 suggesting possible misfit between model and data.

Table 3 also presents path analysis for problem drinking, and women are taken for example. First, the mediator effect of ERI in OC–drinking relation is estimated by multiplying 2 cross–lagged effects: (1) higher OC at wave 1 significantly associated with higher ERI at wave 2 (b = 0.174); (2) higher ERI at wave 1 significantly associated with problem drinking at wave 2 (b = 0.090). This mediator effect of ERI is significant (b =

Table 2
Logistic regression analyses for associations between exposure variables at wave 1 and three drinking outcomes at wave 2, respectively.

Exposure tertile [a]	Binge drinking[b]	Problem drinking[b]	Heavy drinking[b]
ERI or OC	OR (95% CI)	OR (95% CI)	OR (95% CI)
ERI–drinking relations			
Men (n = 3782)			
Tertile 1	1.00	1.00	1.00
Tertile 2	1.51 (1.12–2.04)*	1.27 (0.99–1.63)	1.21 (1.01–1.46)*
Tertile 3	2.29 (1.69–3.07)*	1.79 (1.40–2.28)*	1.33 (1.12–1.57)*
P for trend	<0.001	<0.001	0.002
OR by tertile	1.49 (1.29–1.73)*	1.35 (1.19–1.52)*	1.15 (1.06–1.26)*
Women (n = 3731)			
Tertile 1	1.00	1.00	1.00
Tertile 2	1.52 (0.97–2.37)	1.29 (0.82–2.15)	1.11 (0.91–1.37)
Tertile 3	2.06 (1.34–3.16)*	1.82 (1.13–2.94)*	1.29 (1.04–1.58)*
P for trend	0.001	0.010	0.025
OR by tertile	1.42 (1.16–1.75)*	1.36 (1.08–1.72)*	1.13 (1.02–1.26)*
OC–drinking relations			
Men (n = 3782)			
Tertile 1	1.00	1.00	1.00
Tertile 2	1.24 (0.96–1.60)	1.19 (0.94–1.50)	1.02 (0.87–1.21)
Tertile 3	1.72 (1.32–2.24)*	1.64 (1.29–2.07)*	1.18 (0.99–1.40)
P for trend	<0.001	0.001	0.081
OR by tertile	1.31 (1.15–1.50)*	1.28 (1.13–1.44)*	1.08 (0.99–1.18)
Women (n = 3731)			
Tertile 1	1.00	1.00	1.00
Tertile 2	1.09 (0.75–1.61)	1.39 (0.90–2.14)	1.09 (0.90–1.33)
Tertile 3	1.52 (1.03–2.25)*	1.63 (1.05–2.52)*	1.11 (0.91–1.37)
P for trend	0.036	0.028	0.281
OR by tertile	1.24 (1.01–1.50)*	1.27 (1.03–1.58)*	1.06 (0.96–1.17)

OR: odds ratio; CI: confidence interval.
*P value < 0.05.
[a] Gender–specific tertiles of ER ratio: tertile 1 (0.20–0.32), tertile 2 (0.32–0.47), and tertile 3 (≥0.47) in men; tertile 1 (0.20–0.31), tertile 2 (0.31–0.46), and tertile 3 (≥0.46) in women. Gender–specific tertiles of OC: tertile 1 (6–12), tertile 2 (12–15), and tertile 3 (15–24) in both genders.
[b] Each regression model was adjusted for covariates and corresponding drinking outcome at wave 1.

Table 3
Three path analyses for antecedent or mediator role of OC in relationships between ERI and three drinking outcomes.

Parameters	Path co-efficient	P value	Model fit
Men (n = 3782)			
OC wave 1 → OC wave 2	0.316	<0.001	RMSEA
ERI wave 1 → ERI wave 2	0.242	<0.001	0.055
OC → ERI → Binge drinking	0.021	<0.001	
OC wave 1 → ERI wave 2	0.146	<0.001	CFI
ERI wave 1 → Binge drinking wave 2	0.143	<0.001	0.861
ERI → OC → Binge drinking	0.005	0.077	
ERI wave 1 → OC wave 2	0.079	<0.001	TLI
OC wave 1 → Binge drinking wave 2	0.058	0.054	0.786
Women (n = 3731)			
OC wave 1 → OC wave 2	0.358	<0.001	RMSEA
ERI wave 1 → ERI wave 2	0.251	<0.001	0.062
OC → ERI → Binge drinking	0.020	0.007	
OC wave 1 → ERI wave 2	0.173	<0.001	CFI
ERI wave 1 → Binge drinking wave 2	0.113	0.005	0.837
ERI → OC → Binge drinking	0.003	0.341	
ERI wave 1 → OC wave 2	0.077	<0.001	TLI
OC wave 1 → Binge drinking wave 2	0.038	0.328	0.739
Men (n = 3782)			
OC wave 1 → OC wave 2	0.316	<0.001	RMSEA
ERI wave 1 → ERI wave 2	0.242	<0.001	0.056
OC → ERI → Problem drinking	0.014	0.001	
OC wave 1 → ERI wave 2	0.145	<0.001	CFI
ERI wave 1 → Problem drinking wave 2	0.098	<0.001	0.882
ERI → OC → Problem drinking	0.005	0.048	
ERI wave 1 → OC wave 2	0.078	<0.001	TLI
OC wave 1 → Problem drinking wave 2	0.065	0.031	0.791
Women (n = 3731)			
OC wave 1 → OC wave 2	0.359	<0.001	RMSEA
ERI wave 1 → ERI wave 2	0.252	<0.001	0.061
OC → ERI → Problem drinking	0.016	0.048	
OC wave 1 → ERI wave 2	0.174	<0.001	CFI
ERI wave 1 → Problem drinking wave 2	0.090	0.042	0.840
ERI → OC → Problem drinking	0.004	0.276	
ERI wave 1 → OC wave 2	0.077	<0.001	TLI
OC wave 1 → Problem drinking wave 2	0.053	0.253	0.726
Men (n = 3782)			
OC wave 1 → OC wave 2	0.317	<0.001	RMSEA
ERI wave 1 → ERI wave 2	0.242	<0.001	0.056
OC → ERI → Heavy drinking	0.010	0.009	
OC wave 1 → ERI wave 2	0.146	<0.001	CFI
ERI wave 1 → Heavy drinking wave 2	0.066	0.005	0.848
ERI → OC → Heavy drinking	0.001	0.475	
ERI wave 1 → OC wave 2	0.079	<0.001	TLI
OC wave 1 → Heavy drinking wave 2	0.010	0.453	0.742
Women (n = 3731)			
OC wave 1 → OC wave 2	0.356	<0.001	RMSEA
ERI wave 1 → ERI wave 2	0.253	<0.001	0.062
OC → ERI → Heavy drinking	0.010	0.037	
OC wave 1 → ERI wave 2	0.170	<0.001	CFI
ERI wave 1 → Heavy drinking wave 2	0.056	0.033	0.818
ERI → OC → Heavy drinking	0.001	0.578	
ERI wave 1 → OC wave 2	0.077	<0.001	TLI
OC wave 1 → Heavy drinking wave 2	0.008	0.541	0.708

0.016, p = 0.048). Second, the mediator effect of OC in ERI–drinking relation is estimated by multiplying 2 cross–lagged effects: (1) higher ERI at wave 1 significantly associated with higher OC at wave 2 (b = 0.077); (2) higher OC at wave 1 related to problem drinking at wave 2 (b = 0.053, p = 0.253). This mediator effect of OC is not significant (b = 0.004, p = 0.276).

Comparing three path analyses on different drinking outcomes, those corresponding paths (e.g., Path f for three outcomes) have consistent directions of causality with different magnitudes of effects. In all drinking outcomes, mediator effects of ERI in OC–drinking relations (antecedent roles of OC) are significant. Mediator effects of OC in ERI–drinking relations are not significant across all outcomes except problem drinking in men (p = 0.048).

5. Discussion

This study examined potential roles of OC in ERI–drinking relations in a two–wave cohort study of 7513 middle–aged and older subjects. First, we found that OC had no significantly modifying effects in ERI–drinking relations. Similarly, modifying effects of OC were not supported in 62% of 21 studies in Siegrist and Li's (2016) review. Second, OC and ERI might have bidirectional relationships in the average follow–up period of 3.5 years. In path analyses, we found that OC at wave 1 significantly predicted ERI at wave 2, and ERI at wave 1 significantly predicted OC at wave 2. This finding is consistent with current theories (Caspi et al., 2005) and several cohort studies demonstrating bidirectional relationships between personality and work environment across life span (Roberts et al., 2003; Sutin et al., 2009).

Third, antecedent role of OC in ERI–drinking relations was significant, but mediator role of OC was not. The effect of OC at wave 1 on ERI at wave 2 was remarkably stronger than the reversed causation in this sample with mean age 53.2 years in women and 54.8 years in men. As a meta–analysis reported that personality changes only modestly after age 50 (Roberts & DelVecchio, 2000), we wonder whether the effect of ERI on OC would be stronger in younger populations. Consistent with our finding, an 8-year cohort study among 747 Finnish professionals (mean age 31 years) reported that strong OC predicted later experiences of high ERI, but the reversed causation (ERI predicted later OC) was less remarkable (Feldt et al., 2016).

Antecedent role of OC–related personality in ERI–outcome relations has been somewhat supported in other studies. In a Finnish cohort study (N = 752), Type A behavior measured at adolescence subsequently predicted high ER ratio and high job strain at adulthood (Hintsa et al.,

2010). High neuroticism measured at adolescence was reported to predict high ER ratio and high job strain after 15 years (N = 621) (Hintsanen et al., 2011). Note that the previous studies only examined the pathway from personality to work stress; to our knowledge, this study is the first longitudinal analysis showing the antecedent role of OC in the whole causal path (OC–ERI–outcome).

Finally, traditional epidemiological methods emphasize the identification of independent risk, but critiques addressed relative neglect of antecedent or mediator roles. In our traditional approaches of logistic regression (Table 2), "main effects" of OC on binge drinking and problem drinking were found, consistent with Siegrist and Li's (2016) review supporting main effects of OC in 78% of 27 studies. However, previous evidence may not completely support main effects of OC, as possibilities of antecedent or mediator roles of OC had not been tested by more rigorous methodology like path analysis (MacKinnon, 2008).

5.1. Strengths and limitations

The strengths of this study are a population–based approach with random community samples, a large sample size with strong statistical power, a 2–wave cohort study, and a central protocol across all study centers, and application of advanced statistical methods.

Several limitations should be considered when interpreting the results. First, self–reported measures of alcohol drinking typically underestimate actual consumption. GFQ method appears less prone to underreporting among available alcohol measures. In the HAPIEE study, GFQ–based variables were strongly associated with other measures of alcohol consumption and serum biomarkers (Bobak et al., 2016). Second, Taris and Kompier's (2006) approach was adopted to test mediation by a 2–wave cohort study, using the product of two cross–lagged path coefficients to estimate the mediator effect. A 3–wave cohort study provides the best estimation for mediation: exposure (wave 1), mediator (wave 2) and outcome (wave 3). However, a 2–wave cohort study still can indicate presence of partial mediation (rather than full mediation) and yield better evidence than a half–longitudinal design or a cross–sectional study.

Finally, it is unclear to what extent our findings can be generalized beyond these urban population samples, but socioeconomic and health indicators suggest that these study populations approximately represent their national populations. The effects of ERI on alcohol consumption (Bobak et al., 2005) and health (Salavecz et al., 2010) in CEE/FSU were found not very different from those reported in Western Europe; our findings may have the potential to be generalized to the European populations.

5.2. Practical implications

Recognition of potential roles of personality in work stress–health relations might enhance the ability to help different individuals to deal with work stress. Our findings imply that "antecedent role" of OC in ERI–drinking relations is significant and promising as a potential target for intervention. The meta–analysis of 36 studies found that cognitive behavioral therapy (CBT) consistently produced larger effects on reducing work stress than other interventions (Richardson & Rothstein, 2008). Indeed, there were several intervention studies targeting "cognitive–behavioral mechanisms" via which OC–related personality may influence work stress (Williams & Williams, 2006). Aust et al. (1997) conducted an intervention program including self-observation for perception of arousal, relaxation training, management of conflict, and coping with anger; the mean OC levels were significantly reduced, and the effects persisted after 3 months. Limm et al. (2011) conducted an intervention to foster awareness of stress situations based on the ERI model and to provide coping strategies with stressful situations.

Future individual interventions are suggested to identify and target these cognitive–behavioral mechanisms via which OC may influence work stress: (1) Perception: cognitive appraisal or perceptual distortion of stressful situation – mismatch between effort and reward can be modified by cognitive restructuring. (2) Stressor creation: high OC persons may create real work stressors by time pressure or interpersonal conflict; time management, relaxation and social skill training would be beneficial. (3) Selection: high OC persons may select themselves into stressful jobs; unrealistically high goals and expectations can be changed (Semmer, 2006). (4) Coping with stressful situation: high OC individuals might use alcohol drinking to control negative cognition and emotion; coping strategies can be changed by CBT or mindfulness techniques to observe their urge, thoughts and images without trying to control (Spada et al., 2015). The intervention tailored to individual needs can be designed by firstly evaluating one's personality and specific cognitive–behavioral mechanisms, rather than applying similar techniques to all people.

This study found that OC and ERI might have bidirectional relationships, implying that optimal interventions should focus on both work environment and individual to disrupt accumulated effects in the reciprocal relationships. Individual interventions are effective at individual–level outcomes, but organizational interventions have favorable impacts at organizational–level outcomes like reducing stressful exposures. Superior results would be expected from multi–level interventions combining organizational and individual interventions (Okechukwu et al., 2014). Based on recent research of multi–level interventions, workplace holds substantial potential as an alcohol harm reduction and prevention setting (Pidd et al., 2018).

Ethical statement

The HAPIEE study was approved by the ethics committee at University College London in United Kingdom and by the ethics committee in each participating center.

Availability of data and material

The datasets of the HAPIEE study generated and analyzed in this study are available in publicly available repositories such as the Maelstrom Research (https://www.maelstrom-research.org/study/hapiee) and the SYNCHROS repository (https://repository.synchros.eu/study/hapiee).

Author statement

Author SC, HP and A. Peasey designed this study, wrote the protocol, and conducted the statistical analysis. MB carefully revised the manuscript. MB, RK, SM and A. Pajak designed the HAPIEE study and conducted data collection in three countries. SC conducted literature searches and wrote the draft of the manuscript. All authors read and approved the final manuscript.

Declaration of competing interest

There are no conflicts of interest to declare.

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