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The different areas of chronic stress and food addiction: Results from the LIFE-Adult-Study

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Abstract

There is an empirical association between stress and symptoms of food addiction (FA), but it is still not clear which domains of stress are the most relevant when it comes to FA, limiting the ability of researchers and practitioners to address problematic eating-related health outcomes. In order to address this gap in the literature, we analysed how different domains of chronic stress are related to FA. We used data from a subsample of the LIFE-Adult-Study ($N = 1172$), a German cohort study. We conducted a linear regression analysis with stress domains (Trier Inventory for Chronic Stress, TICS) as predictors of FA (Yale Food Addiction Scale, YFAS). In the second regression analysis we included sociodemographic variables, personality, and smoking as control variables. There was a significant and positive association between Social Overload, Work Discontent, Excessive Demands from Work, and Chronic Worrying and FA. After adding control variables, only Social Overload, Excessive Demands from Work, and Chronic Worrying remained significant predictors. Connections between stress domains and FA can serve as starting points for the development of meaningful interventions that support individuals self-care strategies (Social Overload), complexity management (Excessive Demands from Work), and coping with negative emotions (Chronic Worrying).

1 | INTRODUCTION

Stress is a ubiquitous phenomenon, and it affects everyone from children to older adults (Hill et al., 2018; Osmanovic-Thunström et al., 2015). In addition, stress was linked to a variety of eating-related health problems, from disordered eating to obesity (Hay & Williams, 2013; Tomiyama, 2019). On the neuroendocrinological level, studies showed that the steroid hormone cortisol plays a major role in connecting eating behaviours with stress. That is, multiple studies connected (diurnal patterns in) cortisol levels to eating-related health outcomes from anorexia nervosa to obesity (Adam et al., 2017; Culbert et al., 2016), while meta-analyses suggested positive associations between cortisol concentrations and acute and chronic forms of stress (Prete et al., 2018; Stalder et al., 2017).

This article is focused on the relationship between stress and food addiction (FA). FA is a concept similar to other addictions with potential symptoms including excessive eating, craving, increasing tolerance towards food consumption, and the experience of withdrawal symptoms (Gearhardt et al., 2009, 2012). The association between stress and FA was shown in studies with Korean and Lebanese students (Hong et al., 2020; Najem et al., 2020), Taiwanese young adults (Lin et al., 2020), and German adults (Beyer et al., 2019), and in studies that connected FA with posttraumatic stress disorder (Mason et al., 2014; Mitchell & Wolf, 2016). The connection between stress and FA extends to the level of addictive symptoms. That is, core symptoms refer to the increased amount of food intake and the fact that the consumption continues in spite of knowledge of adverse consequences. Both symptoms can be found in individuals that exhibit binge and emotional eating behaviours, both of which showed clear associations with stress (Fowler et al., 2022; Rosenbaum & White, 2015; van Strien, 2018). Furthermore, studies suggested that mindfulness-based interventions can reduce both forms of disordered eating (Katterman et al., 2014). In addition, studies indicated a connection between stress and the FA symptom food craving (Chao et al., 2015; Sinha, 2018) as well as between increased levels of stress and previous food withdrawal (Morris et al., 2015). Research suggests that these associations could be mediated via brain reward circuits and neuroendocrine systems (Kalon et al., 2016; Wei et al., 2019).

We focus on the association between stress and FA since FA not only represents a pathological form of eating behaviour that was linked to other mental health variables like anxiety, depression, and quality of life (Hussenoeder, Pabst, et al., 2022; Nunes-Neto et al., 2018), but it is also widespread among the population. For example, a systematic review reported prevalences from nonclinical, population-representative samples between 7.9% (Germany) and 15.2% (US) (Oliveira et al., 2021), while a meta-analysis indicated a rate of 15% (95% CI: 11%, 19%) for children and adolescents (Yekaninejad et al., 2021). Moreover, FA is associated with a variety of eating-related health outcomes as meta-analyses showed high prevalences of FA for individuals with overweight/obesity 24.9% (95% CI: 14.2%, 40.1%), binge eating disorder 55% (95% CI: 34%, 75%), and clinically diagnosed eating disorders 57.6% (95% CI: 35.3%, 77.8%) (Praxedes et al., 2022; Pursey et al., 2014). In addition, a study with individuals with anorexia nervosa indicated that 47% of participants were also diagnosed with FA (Tran et al., 2020).

Compared to (clinically diagnosed) eating disorders (sub-clinical) FA is a much more applicable concept for the general population with sufficient variation (Pursey et al., 2014; Schulte & Gearhardt, 2018). In addition, we focus on FA since a better understanding of these behaviours and their connection with stress could contribute to the development of meaningful public mental health measures and the early prevention of severe eating disorders and obesity. However, in order to develop meaningful and efficient measures and interventions, it is important to know specifically which areas of stress are the most relevant when it comes to FA.

The focus of this article is on chronic stress since it represents a form of permanent arousal that prevents mechanisms of relaxation and homoeostasis (Nicolaides et al., 2015) which makes it more problematic in terms of mental health compared to acute forms of stress. Furthermore, chronic stress is associated with alterations in brain physiology and functioning (McEwen, 2017; Oliveira et al., 2016; Tynan et al., 2010). We focus on the nine different chronic stress domains that are measured via the Trier Inventory for Chronic Stress (TICS, Schulz et al., 2004): (1) Work Overload, (2) Social Overload, (3) Pressure to Perform, (4) Work Discontent, (5) Excessive Demands from Work, (6) Lack of Social Recognition, (7) Social Tensions, (8) Social Isolation, and (9) Chronic Worrying. On the one hand, studies suggested an increase of unhealthy and excessive eating following stress (Masih et al., 2017; Pool et al., 2015), and emotional eating theory implies that eating can function as a way of coping with negative emotions (Macht & Simons, 2011). On the other hand, research indicated that disordered eating behaviours may affect stress regulation via neuroendocrinological pathways (Sinha, 2018). Hence, in general, we expect positive associations between chronic stress domains and FA.

With our work, we want to fill a gap in the literature by analysing the relationships between these different domains of chronic stress and FA with data from a German cohort study. We want to identify those domains as a basis for further research and future public mental health measures.

2 | METHODS

2.1 | Study design

The Adult Study of the Leipzig Research Centre for Civilization Diseases (LIFE) is a unique collaboration of several clinical and

epidemiological research teams, and a large population-based cohort study in the city of Leipzig, Germany. Participants between 18 and 80 years of age were recruited through age- and gender-stratified random selection by the local residents' registry office between 2011 and 2014, with pregnancy being the only exclusion criterion. In the age group of 40–79 years the response rate was 31.0%, in the age group of 18–39 years it was 16.6%. After participants provided written informed consent, they underwent a set of assessments, including questionnaires, interviews, and medical examinations. Hence, the study covers a wide set of health-related variables including socio-demography, psychosocial variables (mental) health, life style, sleep, and cognition. Details on study design and assessments can be found elsewhere (Engel et al., 2023; Loeffler et al., 2015). For our research, we used a subsample of 1570 participants that filled out the TICS questionnaire. After excluding participants with missing values, the final sample contained 1172 participants from the baseline assessment that had been conducted from August 2011 to November 2014.

2.2 | Measures

2.2.1 | Sociodemographic variables

Participants provided information on age, gender, and marital status in standardized interviews conducted by trained study personnel. They were also asked for details on education, occupational status, and equivalent household income that were used to determine their socioeconomic status (Lampert et al., 2013).

2.2.2 | Stress

The TICS (Schulz et al., 2004) was used to measure nine interrelated areas of chronic stress with 57 items. These areas are (1) Work Overload (e. g., 'I have too many tasks to perform.'), (2) Social Overload (e.g. 'I must frequently care for the well-being of others.'), (3) Pressure to Perform (e.g. 'I have tasks to fulfil that pressure me to prove myself.'), (4) Work Discontent (e.g. 'Times when none of my tasks seem meaningful to me.'), (5) Excessive Demands from Work (e.g. 'Although I try, I do not fulfil my duties as I should.'), (6) Lack of Social Recognition (e.g. 'Although I do my best, my work is not appreciated.'), (7) Social Tensions (e.g. 'I have unnecessary conflicts with others.'), (8) Social Isolation (e.g. 'Times when I have too little contact with other people.'), and (9) Chronic Worrying (e.g. 'Times when I worry a lot and cannot stop.' [item translation from Petrowski et al. (2012)]. For the TICS, participants give information on how often they have experienced a specific situation or experience within the last 3 months on a Likert scale from 'never' (0) to 'very often' (4). Scoring was performed according to the manual, resulting in a composite score for each stress area. Higher scores represent higher levels of stress, and scores may range from 0 to 4. The TICS also includes a Chronic Stress Screening Scale that is based on 12 items

from some of the chronic stress areas and that ranges from 0 to 48. The TICS provides good psychometric properties in a representative German sample (Petrowski et al., 2012).

2.2.3 | Food Addiction

FA was assessed via the Yale Food Addiction Scale (YFAS; Gearhardt et al., 2009, 2012). The scale consists of 25 items with dichotomous and Likert-type response categories. The seven subscales represent the criteria for an eating addiction in line with the guidelines for substance dependence according to the DSM-IV: (1) the substance is taken in larger amounts and for longer periods than intended; (2) a persistent desire or repeated unsuccessful attempts to quit; (3) much time/activity to obtain, use, and recover; (4) important social, occupational, or recreational activities are given up or reduced; (5) the use continues despite knowledge of adverse consequences; (6) tolerance; and (7) withdrawal symptoms. The subscales were computed using the algorithm proposed in Gearhardt et al. (2009), and the item representing clinical significance was excluded, so that the YFAS score resembles a symptom count without diagnosis. Scores range from 0 to 7, and higher scores represent higher levels of FA. The YFAS provides good psychometric properties in a German sample (Meule et al., 2012).

2.2.4 | Covariates

In order to assess the Big Five personality traits, that is, Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness, participants were asked to fill out the revised German version of the Ten Item Personality Inventory (TIPI; Herzberg & Brähler, 2006) which comprises 16 items that can be answered on a scale from 1 to 7. Participants were also asked if they are smokers, ex-smokers, or non-smokers. For the analysis we constructed a binary variable with 1 = 'smokers' and 0 = 'ex-smokers and non-smokers'. We included personality and smoking since studies indicate a relationship with FA (Brunault et al., 2018; Mies et al., 2017).

2.3 | Statistical analyses

We used IBM SPSS (version 27) for statistical analyses. A correlational analysis (Pearson's correlation, two-tailed) and a linear regression analysis were conducted. A significance level of 0.05 was assumed for all statistical evaluations. For the regression analysis, we used all areas of chronic stress as predictors (Work Overload, Social Overload, Pressure to Perform, Work Discontent, Excessive Demands from Work, Lack of Social Recognition, Social Tensions, Social Isolation, and Chronic Worrying) and FA as outcome. In the second regression analysis we included age, gender, socioeconomic status, marital status, personality, and smoking as control variables. Before the regression analyses, we checked for multicollinearity using the

correlation matrix of our predictors as well as the variance inflation factors (VIF). There were no VIFs above 3.0 in both regressions suggesting that multicollinearity is not a problem in our sample (James et al., 2017; Vittinghoff et al., 2011).

3 | RESULTS

Our sample contained 1172 participants with a mean age of 54.7 years, 42.8% were female. Table 1 gives an overview on the general characteristics of the sample. Compared to the other participants in the LIFE-Adult-Study at baseline (not displayed), participants in our sample were younger ($M = 54.7$ years/$SD = 16.8$ vs. $M = 57.8$/$SD = 11.7$, $t(1327) = −6.20$, $p < 0.001$), less likely to be female (42.8% vs. 53.6%), married (57.0% vs. 63.2%), and smoking (16.6% vs. 22.7%), and slightly lower in terms of SES (low: 16.2% vs. 20.5%/medium: 58.9% vs. 60.3%/high: 24.9% vs. 19.1%, $\chi^2(2) = 27.45$, $p < 0.001$). Participants in our sample exhibited slightly lower levels of Neuroticism ($M = 3.2$/$SD = 1.1$ vs. $M = 3.3$/$SD = 1.1$, $t(7678) = −2.38$, $p = 0.018$), Agreeableness ($M = 5.8$/$SD = 1.0$ vs. $M = 5.9$/$SD = 1.0$, $t(1592) = −3.05$, $p = 0.002$), and Conscientiousness ($M = 5.8$/$SD = 0.9$ vs. $M = 5.9$/$SD = 0.8$, $t(1538) = −3.24$, $p < 0.001$), but there were no significant differences with regard to Extraversion ($M = 3.6$/$SD = 1.2$ vs. $M = 3.6$/$SD = 1.2$, $t(7678) = −0.46$, $p < 0.649$) and Openness ($M = 5.4$/$SD = 0.9$ vs. $M = 5.4$/$SD = 0.9$, $t(7678) = 0.59$, $p < 0.552$). Stress and FA were not assessed for all participants in the baseline sample; hence, no comparisons are presented.

Table 2 shows that all areas of chronic stress significantly and positively correlated with each other and with FA. Correlations between FA and stress are small (Cohen, 1988), ranging from 0.16 (Pressure to Perform) to 0.28 (Excessive Demands).

Table 3 shows significant, positive associations between Social Overload, Work Discontent, Excessive Demands, Chronic Worrying, and FA. After adding control variables, only the associations between Social Overload, Excessive Demands, Chronic Worrying, and FA remained significant. From the control variables, only Conscientiousness exhibited a significant, negative association with FA, while there was no association with age, gender, socioeconomic status, marital status, Neuroticism, Extraversion, Openness, Agreeableness, and smoking.

4 | DISCUSSION

The correlational analysis showed highly significant associations between all domains of chronic stress and FA, while the multivariate analysis showed positive associations between Social Overload, Work Discontent, Excessive Demands, Chronic Worrying, and FA. After adding control variables, that is, sociodemographic variables, personality traits, and smoking, Social Overload, Excessive Demands, and Chronic Worrying still significantly predicted the FA symptom

TABLE 1 General characteristics of the study sample.

	Total group (N = 1172)
Age (years)	54.7 (16.8)
Gender ('female')	502 (42.8%)
Socioeconomic status[a]	
Low	190 (16.2%)
Medium	690 (58.9%)
High	292 (24.9%)
Marital status ('married')	668 (57.0%)
Personality (TIPI; range: 1–7)	
Neuroticism	3.2 (1.1)
Extraversion	3.6 (1.2)
Openness	5.4 (0.9)
Agreeableness	5.8 (1.0)
Conscientiousness	5.8 (0.9)
Stress (TICS; range: 0–4)	
Work overload	1.2 (0.8)
Social overload	1.4 (0.8)
Pressure to perform	1.5 (0.8)
Work discontent	1.1 (0.6)
Excessive demands from work	0.8 (0.6)
Lack of social recognition	1.1 (0.7)
Social tensions	0.9 (0.6)
Social isolation	1.0 (0.7)
Chronic worrying	1.2 (0.8)
Stress screening (TICS; range: 0–48)	12.7 (7.4)
Smoking ('yes')	195 (16.6%)
Food addiction (YFAS; 0–7)	1.4 (0.9)

Note: Continuous variables are given as mean (standard deviation); categorical variables are displayed as numbers (percentages).
[a]Socioeconomic status was computed based on education, occupational status, and equivalent household income (Lampert et al., 2013).

score. While some studies showed connections between sociodemographic variables, personality, and FA (Brunault et al., 2018; Pursey et al., 2014), they cannot be replicated in our data (with the exception of Conscientiousness). Most likely this lack of association is due to the fact that our analysis is built on a broad sample of the population while other studies focus on specific samples with individuals with overweight, obesity, or eating disorders. Our results showed a mean number of 1.4 FA symptoms, which is below the symptom scores that we find in other studies with French adults (1.9; Brunault et al., 2014) and US students (1.8; Murphy et al., 2014), but it matches with a current meta-analysis that found a lower prevalence for FA in Germany compared to other countries (Oliveira et al., 2021).

TABLE 2 Correlations between areas of chronic stress and food addiction (N = 1172).

	1	2	3	4	5	6	7	8	9	10
1. Work overload	1									
2. Social overload	0.65	1								
3. Pressure to perform	0.67	0.69	1							
4. Work discontent	0.34	0.24	0.33	1						
5. Excessive demands	0.54	0.33	0.40	0.57	1					
6. Lack of S. recognition	0.51	0.42	0.47	0.53	0.55	1				
7. Social tensions	0.41	0.44	0.45	0.42	0.48	0.50	1			
8. Social isolation	0.23	0.19	0.25	0.57	0.42	0.39	0.34	1		
9. Chronic worrying	0.48	0.37	0.35	0.49	0.61	0.42	0.46	0.48	1	
10. Food addiction	0.20	0.18	0.16	0.24	0.28	0.18	0.18	0.19	0.27	1

Note: Pearson's correlation. All correlations are significant at $p \leq 0.001$.

Social Overload is related to the strain resulting from having to care for the needs and wants of other people, and our data shows a clear association with FA. These results are in line with other studies that connected jobs and practices that involve high levels of caring for others and of prioritising the needs of others over one's own to pathological eating. For example, researchers found that call centre employees that experienced negative interactions with customers exhibited overeating behaviours (Liu et al., 2017), and that Korean nurses exhibited a higher prevalence for binge eating disorder than the general population (Kim et al., 2018). In addition, a study showed increased body weight and long term excessive intake of energy in a sample of older caregivers (Torres et al., 2010).

FA and Social Overload have in common that they both represent a form of overwhelming demand/urge, either in the form of external demands by others or in the form of an internal urge for food consumption. Furthermore, we did not find any significant associations between FA and the other social stress domains that lack this overwhelming nature, that is, Lack of Social Recognition, Social Tensions, and Social Isolation. Hence, our results indicate that intervention measures should strengthen the ability of individuals to understand and control these demands. On the systemic level this could imply changes to the organisation of work that allow employees in jobs with great levels of Social Demand to distance themselves from those demands, for example, in the form of reduced working hours and regular breaks. Studies already showed connections between reduced working hours, regular eating schedules, and overweight in nurses (Han et al., 2011; Nahm et al., 2012). On the individual level, interventions that focus on self-care could be a way to address Social Overload, and there are already promising results from interventions with nurses (Delaney et al., 2015; Kravits et al., 2010). In addition, social skills training interventions could help individuals to better cope with demands from other people and social overload.

Excessive Demands from Work refers to chronic stress that is related to the complexity of work tasks, and it is significantly and positively associated with FA. These results could be a consequence of the fact that complex tasks make it more difficult to predict, organise, and affect work processes and outcomes as well as to identify and value individual contributions. Hence, work complexity could have an impact by affecting the satisfaction of a variety of fundamental human needs and motivations at the workplace. For example, these needs are related to job control (Day et al., 2017; Svane-Petersen et al., 2020), mastery (Belfrage et al., 2018; Crowe et al., 2016), and professional recognition (Renger et al., 2020). In addition, the sheer quantity of work (Work Overload), pressure from others (Pressure to Perform), or the fact that tasks do not match with the individual's interests (Work Discontent) do not predict FA in our sample once the control variables are added. From an intervention perspective, problems related to complexity could be addressed by leadership training that helps managers to reduce and adapt complexity for their employees. In addition, considering future increases in job complexity in many areas of work and beyond due to processes of acceleration (Rosa et al., 2017), globalisation (Torp & Reiersen, 2020), and digitalisation (Christensen et al., 2020), interventions also need to help employees to better accept and deal with the complexities in their (work) lives. These interventions could include time management strategies as well as problem solving skills.

Chronic Worrying was a significant predictor of FA, matching with other research showing that the TICS-domain Chronic Worrying is associated with higher levels of anxiety (Hussenoeder, Conrad, Pabst, Engel, et al., 2022) and depression (Hussenoeder, Conrad, Pabst, Luppa, et al., 2022), and that worry is associated with a variety of eating disorders (Fewell et al., 2017; Palmieri et al., 2021). In the Contrast Avoidance model it is argued that worrying could be seen as a dysfunctional coping mechanism that helps individuals with anxiety to prevent sharp increases in negative emotion by maintaining a constant level of negativity (Kim & Newman, 2022; Llera & Newman, 2014). While the model was originally developed in the context of generalised anxiety disorder (Newman & Llera, 2011), recent research suggested that it can be applied more broadly (Rashtbari et al., 2020). The connection between chronic worrying and addictive eating in our data could point to a combination of detrimental coping

TABLE 3 Prediction of food addiction by areas of chronic stress with and without control variables (standardized regression coefficients; $N = 1172$).

	Food addiction	
	β	β
Domains of chronic stress		
Work overload	−0.00	−0.02
Social overload	0.09*	0.10*
Pressure to perform	−0.02	−0.02
Work discontent	0.10*	0.08
Excessive demands from work	0.14***	0.14***
Lack of social recognition	−0.04	−0.04
Social tensions	0.00	0.01
Social isolation	0.02	0.01
Chronic worrying	0.12**	0.11*
Age		0.02
Gender (female)[a]		−0.00
Socioeconomic status (low)		
Medium		0.00
High		−0.04
Marital status (married)[b]		0.07
Personality		
Neuroticism		0.01
Extraversion		0.02
Openness		0.01
Agreeableness		0.04
Conscientiousness		−0.08**
Smoking (non-smoker)		−0.01
R^2	0.11	0.12

[a]The category coded as '0' (= reference category) is presented in parentheses.

[b]Marital status: 0 = married; 1 = not married.

*$p \leq 0.05$; **$p \leq 0.01$; ***$p \leq 0.001$.

strategies that address negative emotions. Hence, our results indicate that interventions should address the underlying negative emotions and support the development of more adequate coping strategies, in order to improve worrying as well as FA. Such interventions may include mindfulness-based stress reduction, Tai Chi, and cognitive reappraisal (Khoury et al., 2015; Wang et al., 2021; Zhang et al., 2019).

4.1 | Limitations

While our study has several strong points, like the multi-domain approach to chronic stress, sample size, and the inclusion of various covariates, such as the Big Five personality traits, it also has some limitations. First, since the current study is cross-sectional, future research would benefit from a longitudinal design to analyse the direction of causality between stress domains and FA. Second, there may be a selection bias due to the low response rate especially for younger participants, and individuals that took part in the study may differ from those that did not, for example, with regard to SES as well as health awareness and behaviours. In addition, participants in our study are not representative for Leipzig in terms of gender and age. Third, future research may include physiological measures and brain imaging techniques to assess the systemic and neurobiological underpinnings of interactions between stress and FA.

5 | CONCLUSION

We found an empirical connection between the chronic stress domains Social Overload, Excessive Demands from Work, Chronic Worrying, and FA. These findings indicate that intervention measures should increase the ability of individuals to understand and control social demands and practice self-care (Social Overload), focus on building leadership and employee skills with regard to complexity (Excessive Demands from Work), and help individuals with dealing with negative emotions and/or developing more adequate coping strategies (Chronic Worrying).

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

ETHICS STATEMENT

The LIFE-Adult-Study is conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of the Medical Faculty of Leipzig University (approval numbers 263-2009-14122009, 263/09-ff, 201/17-ek). Written informed consent was obtained from all participants.

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