FACULTY OF MEDICINE AND HEALTH SCIENCES

WORK-RELATED STRESS AMONG ACADEMIC STAFF

RELATION BETWEEN UNDERLYING EXPOSURE TO AND DAY-TO-DAY EXPERIENCE OF PSYCHOSOCIAL STRESS AND ADHERENCE TO AN ECOLOGICAL MOMENTARY ASSESSMENT (EMA) PROTOCOL - BASED ON THE PILOT STUDY FOR THE STRESS AT WORK (STRAW) PROJECT

Word count: 9999

Amber Shen
Student number: 01710888

Supervisor: Prof. Dr. Els Clays
Cosupervisor: Larissa Bolliger (PhD student)

A dissertation submitted to Ghent University in partial fulfilment of the requirements for the degree of Master of Science in Health Promotion

Academic year: 2019-2020

UNIVERSITEIT GENT

FACULTY OF MEDICINE AND HEALTH SCIENCES

WORK-RELATED STRESS AMONG ACADEMIC STAFF

RELATION BETWEEN UNDERLYING EXPOSURE TO AND DAY-TO-DAY EXPERIENCE OF PSYCHOSOCIAL STRESS AND ADHERENCE TO AN ECOLOGICAL MOMENTARY ASSESSMENT (EMA) PROTOCOL - BASED ON THE PILOT STUDY OF THE STRAW PROJECT

Word count: 9999

Amber Shen
Student number: 01710888

Supervisor: Prof. Dr. Els Clays
Cosupervisor: Larissa Bolliger (PhD student)

A dissertation submitted to Ghent University in partial fulfilment of the requirements for the degree of Master of Science in Health Promotion

Academic year: 2019-2020

UNIVERSITEIT GENT

Table of contents

List of abbreviations **7**

Introduction **8**

Abstract **12**

Abstract – NL **13**

1. Literature study **14**

1.1 A definition of stress *14*
1.1.1 Acute stress 15
1.1.2 Chronic stress 16

1.2 Stress at work *16*
1.2.1 Theoretical models 17
1.2.2 Sources of stress at work 19
1.2.3 Academic working environment 20
1.2.4 Effects of work-related stress 21

2. Methods **23**

2.1 Research design *23*

2.2 Participants *23*

2.3 Procedure *23*

2.4 Methods of data collection *25*
2.3.1 Baseline screening 26
2.3.2 STRAW-app 26
2.3.3 Empatica® wristband 27

2.4 Measures thesis *28*

2.4 Statistical analyses *29*
2.6.1 Correlation 29
2.6.2 Adherence 29

3. Results **31**

3.1 Sociodemographic variables *31*

3.2 Correlation *33*
3.2.1 Descriptive statistics 33
3.2.2 Main effect – Time 44
3.2.3 Main effect – Baseline 44
3.2.4 Full factorial model 50
3.2.5 Crude model 52

3.3 Adherence to EMA protocol *54*
3.3.1 Entry completion 54
3.3.2 Completion time and delay in response 56
3.3.3 Underlying exposure and adherence 63

4. Discussion 70

4.1 Correlation 70

4.2 Adherence 71

4.3 Strengths and limitations 72

5. Conclusion 74

5.1 Recommendations 74

Reference list 75

Appendices 82

Appendix A: Permission Committee for Medical Ethics – STRAW-Project: Disentangling the sources and context of day-to-day STRess At Work. 82

Appendix B: Permission Committee for Medical Ethics – Thesis: How does overall psychosocial stress influence day-to-day stress situations at work? 84

Appendix C: Informed Consent 86

Appendix D: List of Scales and Questionnaires 87

Appendix E: Overview (work)Stress Scales in Baseline Screening and EMA 90

Appendix F: Coding Book – Correlation 92

Appendix G: Coding Book - Adherence 94

Appendix H: Field Hours Log 96

List of figures 102

List of tables 105

Acknowledgements

To be honest, this paper was one of the biggest challenges I have experienced so far. And now, looking at the result, I feel proud of myself. However, writing a paper depends not only on the author's knowledge, efforts or writing skills, but also on the support that was received from those around him or her. I was fortunate to experience this kind of support, therefore I would like to dedicate this part of the paper to show my gratitude to these specific people.

First of all, I would like to thank Professor Clays for the opportunity to collaborate on this study under her supervision. I would also like to thank her for the support and guidance throughout this thesis, and especially for sharing her knowledge and insights.

Next, I would like to thank Larissa Bolliger (PhD student) with whom I worked closely on the STRAW-Project. Without her, there would not have been any research in the first place, and I would not have received the opportunity to learn as much as I have now. I am very grateful for her enduring support and well-timed motivational speeches.

I would also like to express my gratitude to Bea, Carolien, Celine, Eline, Heleen and my aunt for proofreading my thesis as well as my friends, family and boyfriend for the unconditional emotional support.

Last but not least, I would like to express my thanks to Rani. Whilst we were no official duo thesis partners, we worked side-by-side on the STRAW-Project. Throughout the process, we complemented each other perfectly. So thank you, Rani, for the great cooperation and support. You always managed to get me motivated again in difficult times.

And thank you, reader, for taking the time to go through my thesis. I hope you enjoy reading it!

List of abbreviations

Abbreviation	*Explanation*
AL	Allostatic load
ANS	Autonomic nervous system
BS	Baseline screening
CVD	Cardiovascular disease
D/C	Demands/control
EMA	Ecological momentary assessment
ERI	Effort reward imbalance
HPA-axis	Hypothalamic-pituitary-adrenocortical axis
JCQ	Job content questionnaire
JDC	Job demand control
JDCS	Job demand control support
LMM	Linear mixed model
MSDs	Musculoskeletal disorders
PNS	Parasympathetic nervous system
SNS	Sympathetic nervous system
STRAW	STRess At Work

Introduction

Occupational health researchers have become increasingly interested in work-related psychosocial stress and its effects on health. Several studies reported a consistent link between stressful working conditions and adverse health effects, such as cardiovascular disease (Theorell et al., 2016), musculoskeletal symptoms (de Kok et al., 2019; Jun, 2020) and psychological distress (FOD WASO, 2007; Rose et al., 2017). These effects have a considerable impact on individuals, but also impose an economic burden on organisations and society, through loss of productivity in employees (Pereira et al., 2017).

Despite the large body of studies researching work-related stress, fewer studies have yet been devoted to examining stress among employees in an academic working environment. For a long time, it was believed that academics experienced low job strain and low work-related stress, due to a high level of job control and academic freedom that was characterising for the academic working environment. However, several studies (Franco-Santos & Doherty, 2017; Hyde et al., 2013; Morrish & Sauntson, 2016) pointed to an increase in job demands (i.e., increasing quantity and diversification of tasks and roles), as a result of managerial changes in the academic sector. These changes were linked to the introduction of the New Managerialism or New Public Management, shifting the focus on performance and financial targets (Franco-Santos & Doherty, 2017).

The study of Kinman and Wray (2015) demonstrated an increase in work-related stress among higher education employees in recent years, with almost 80% of the participants reporting their job as stressful. This study also pointed to a reduction in job control, which used to be a key characteristic in the academic setting and was supposed to counteract with the high demands. Moreover, academic employees reported less job satisfaction, difficulties to maintain a work-life balance and poorer mental health (Kinman & Wray, 2015). Several studies also demonstrated higher levels of perceived work-related stress and a higher risk of depression and anxiety in academic staff, compared to other occupational groups (Fontinha et al, 2019; Levecque et al., 2017; Mark & Smith, 2012). The rapidly changing nature of the academic environment and the corresponding level of stress imply a threat to occupational health and wellbeing of academic employees. For this reason, it is imperative to gain more insight into work-related stress among this specific population.

The main purpose of the STRess At Work (STRAW) Project is to provide more scientific evidence on work-related stress in an academic setting in order to address work-related stress in this specific context. First of all, it is indispensable to provide more information about the overall project, within which the pilot study and thesis were carried out. The STRAW-Project is a collaboration between Ghent University and the Jozef Stefan Institute in Ljubljana, Slovenia. The project aims to identify sources of day-to-day stress at work and examines the context in which it occurs. The knowledge and insight gained, can be valuable in the development of effective prevention strategies for stress management at work. A non-experimental, quantitative study is conducted to seek answers for the following research question (based on the STRAW-Project protocol paper, in progress): *"How are relationships between 1) work environment risk factors (i.e. stressors), 2) self-perceived stress outcomes (i.e. consequences of stress) experienced in occupational settings, 3) physiological stress parameters, and 4) context as inferred from smartphone sensor data in office-based workers - employed in academic settings - best modelled?".*

The study is carried out in Slovenia and Belgium, among 100 male and female participants with office-based work in an academic working environment. The sample in Belgium is achieved via convenience sampling and consists of 50 Flemish employees working either at Ghent University or Odisee Hogeschool. The participants are recruited via e-mail or by voluntary response to the posters and flyers distributed on the campuses of both universities. Data collection is carried out during three weeks, which includes a moment of briefing and debriefing. Three different data collection methods are applied, involving a baseline screening, the STRAW-app (Ecological Momentary Assessment and smartphone sensor data) and the Empatica® wristband.

A pilot study was carried out as part of the STRAW-Project and was embedded in the project. As included in every solid pilot study, the feasibility of the research protocol was investigated. Feasibility is an *umbrella* concept, covering different factors such as adherence. The pilot study included five participants, and one focus was on adherence to the day-to-day EMA protocol. The procedure is similar to this of the STRAW-Project. A profound description is available in the 'Methods' section. This thesis is a contribution to the PhD work of Larissa Bolliger, which includes the STRAW project. The tasks included translations in English and Dutch, the creation of the baseline screening, data cleaning and data-analyses.

This thesis was based on data from the pilot study. As can be deduced from the title, this thesis includes two research questions. The original aim was to focus on the influence of underlying exposure to psychosocial stress on the experience of day-to-day stress situations at work among employees in an academic working environment. However, during the project the

emergence of the COVID-19 pandemic took place. As it affected our daily lives, so did it influence the data collection of the project. Due to the unusual circumstances, data collection had to be discontinued resulting in a smaller sample size than foreseen. Fortunately, this issue could be addressed by extending the purpose of this thesis to research on adherence to the EMA protocol. Given the multiple measuring methods, it was decided to focus on one measuring method. Accordingly, adherence to the EMA protocol and more specifically adherence to the morning and daytime EMAs were examined. In this thesis, the baseline screening and EMA data were used for statistical analyses. Following research questions were sought answers to:

1. *Is there a correlation between underlying exposure to psychosocial stress among personnel employed in an academic sector and the experience of day-to-day stress situations at work?*
2. *Is participants' adherence towards the day-to-day EMA protocol influenced by underlying exposure to psychosocial stress?*

The concept of stress is not carved in stone. Consequently, different nuances for this term are given in research. It is therefore essential to somewhat outline the meaning of terms and concepts involved in this thesis. An important concept of this thesis is common day-to-day stress. Daily hassles are described by Lazarus and Cohen (1977) as one of the three basic types of environmental sources of stress. Contrary to these other stress sources (i.e., cataclysmic phenomena and life events affecting smaller groups or individuals), daily hassles encompass stable stressors, occurring repeatedly or chronically (Lazarus & Cohen, 1977). They can impose a significant problem through their possible effect on health outcomes and wellbeing (Lazarus & Folkman, 1984). Major changes are more often researched due to the obvious reason that they can be ascertained more easily. However, so-called daily hassles allow a better prediction of the psychological and physiological outcomes (Lazarus & Folkman, 1984).

Another key concept of this thesis is psychosocial stress. This term originates from the psychological and sociological field. Having a difference in meaning within research, it is frequently used interchangeably with psychological stress, and will accordingly be applied in this thesis. According to Martikainen et al. (2002), the term *psychosocial* operates as an *umbrella* term for health research. It is used in many diverse ways and often linked to different theoretical frameworks. When explaining psychosocial stress and its relation to health outcomes, it seems useful to consider the definition of *health* and the definition of the term *psychosocial*.

The World Health Organization (WHO, 2020, Constitution, para. 1) defined health as "*a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*." The description of the term *psychosocial* by the Oxford English dictionary (as cited by

Martikainen et al., 2002) included *"pertaining to the influence of social factors on an individual's mind or behaviour, and the interrelation of behavioural and social factors*".
Considering these two definitions it seems that psychosocial factors can influence health outcomes, directly and indirectly. This is also seen in Figure 1, in which psychosocial factors are situated in the meso level and affect health outcomes, through modified health behaviours and biological processes (Martikainen et al., 2002).
Finally, the main focus of this thesis lies in the chronic or underlying exposure of psychosocial stress at work. These two concepts are traditionally handled as the same phenomenon. A clear and thorough explanation of the terms is given in the literature study.

Figure 1 A tentative schematic representation of psychosocial pathways. Reprinted from "Psychosocial determinants of health in social epidemiology" by Martikainen, Bartley and Lahelma, 2002, International Journal of Epidemiology, 31, p. 1091–1093. Copyrighted 2002, International Journal of Epidemiology, 31, p. 1091 – 1093. Copyrighted 2002 by Oxford University Press.

This thesis is similarly constructed to scientific articles, starting with an abstract in English and Dutch. The literature study, subsequently, starts with a broad description of the concept of stress and narrows down to work-related stress, with the two most cited theoretical models for work-related stress as well as the sources of work-related stress and negative effects on health and wellbeing. The methodology of the pilot study and this thesis is described as well, followed by the study results, and a critical discussion on the obtained results. The previous parts will lead to a conclusion, which will give answers to the research questions and recommendations for further research.

Abstract

Background Several studies reported an increased level of stress in recent years among academic personnel, resulting in detrimental effects on health and wellbeing of employees. However, the current body of scientific evidence concerning stress in this specific work context remains limited.

Objectives The purpose of this thesis is to identify associations between underlying exposure to psychosocial stress and experiences of day-to-day stress situations at work among academic staff. Further, participants' adherence to the Ecological Momentary Assessment (EMA) protocol was explored.

Methods A pilot study was carried out among employees in an academic setting, as part of the STRAW-Project. The Job Content Questionnaire was used to assess psychosocial work-related factors at baseline and during the repeated EMAs in the STRAW-app. Linear mixed models and descriptive statistics were used to examine possible associations. A Spearman correlation was utilised for examining an association between underlying psychosocial stress and adherence towards the EMA protocol.

Results A total of five female employees working for Ghent University were included in the pilot study. Time was significantly associated with underlying exposure to job demands. Also, a significant association was found between underlying exposure and day-to-day experiences of supervisor support. No significant associations were found between underlying exposure to work-related stress and adherence to the EMA protocol.

Conclusions Based on these five participants, no obvious patterns were found in experiences of day-to-day stress situations at work. Furthermore, challenges were found concerning adherence to the EMA protocol, such as delay in response and completion time.

Wordcount thesis: 9999

Abstract – NL

Achtergrond Verschillende studies rapporteerden een recente toename in stress bij academisch personeel, met schadelijke gevolgen voor de gezondheid en het welzijn van deze werknemers. Huidige wetenschappelijke kennis van stress in deze specifieke werkcontext blijft echter beperkt.

Doelstellingen Het doel van deze thesis is het identificeren van associaties tussen onderliggende blootstelling aan psychosociale stress en het ervaren van dagelijkse stress situaties op het werk bij academisch personeel. Tevens werd onderzoek gedaan naar participanten hun naleving van het Ecological Momentary Assessment (EMA) protocol.

Methode Een pilootstudie werd uitgevoerd bij werknemers in een academische setting, als onderdeel van het STRAW-project. De Job Content Questionnaire werd gebruikt om psychosociale werk-gerelateerde factoren te meten bij de nulmeting en tijdens de herhaalde EMAs in de STRAW-app. Lineaire mixed models en beschrijvende statistiek werden gebruikt om mogelijke associaties te onderzoeken. Een Spearman correlatie werd gebruikt voor het nagaan van een verband tussen onderliggende psychosociale stress en naleving van het EMA protocol.

Resultaten Vijf vrouwelijke medewerkers van Universiteit Gent werden opgenomen in de studie. Tijd was significant geassocieerd met de onderliggende blootstelling aan job eisen. Een significant verband werd gevonden tussen de onderliggende blootstelling aan en de dagelijkse ervaring van steun van een supervisor. De onderliggende blootstelling aan werk-gerelateerde stress was niet significant geassocieerd met naleving van het EMA-protocol.

Conclusies Op basis van de participanten, werden geen duidelijke patronen gevonden in de ervaringen van dagelijkse stresssituaties op het werk. Verder werden uitdagingen blootgelegd bij de naleving van het EMA-protocol, zoals de vertraging bij het antwoorden en de invultijd.

Aantal woorden masterproef: 9999

1. Literature study

This thesis aims to research how underlying exposure to psychosocial stress among employees in an academic working environment influences the experience of day-to-day stress situations at work. Furthermore, the influence of underlying exposure to psychosocial stress on participants' adherence towards the day-to-day EMA protocol was investigated, with the focus on adherence to daytime questionnaires. This work aims to answer the following two research questions:

1. *Is there a correlation between underlying exposure to psychosocial stress among personnel employed in an academic sector and the experience of day-to-day stress situations at work?*
2. *Is participants' adherence towards the day-to-day EMA protocol influenced by underlying exposure to psychosocial stress?*

1.1 A definition of stress

Considering the abundance of different interpretations of stress, it is not convenient to formulate one solid definition. Selye (1976) described stress as "*the nonspecific response of the body to any demand made upon it*" (p.137). In his stimulus-response approach stress factors are referred to as "*stressors*" (p.139). According to Lazarus (1966), it is crucial to look at stress as "*a concept involving different variables and processes*", rather than just a single variable (Lazarus, as cited by Lazarus & Folkman, 1984, p. 11-12).

Lazarus and Folkman (1984) developed a cognitive theory of stress based on a transactional model that involves a "*mutually reciprocal, bidirectional relationship*" between a person and his environment that can be influenced by personal or situational factors (p. 293). The transactional theory describes that stress occurs when a person appraises a specific interaction between these two factors as "*taxing or exceeding his or her resources and endangering his or her well-being*" (Lazarus & Folkman, 1984, p. 19).

The theory of Lazarus and Folkman (1984) is referenced by many researchers. Based on the key variables and different processes in this well-used theory, an overview (Figure 2) was constructed, comprising stress factors (i.e., situational or personal factors), appraisal, coping, and outcomes. When the relationship between a person and the environment is compromised, the process of cognitive appraisal is initiated. If the environmental demands are evaluated as stressful (i.e., primary appraisal) adequate coping strategies (i.e., secondary appraisal) are selected, determining the immediate and long-term effects of adaptation (Lazarus & Folkman, 1984).

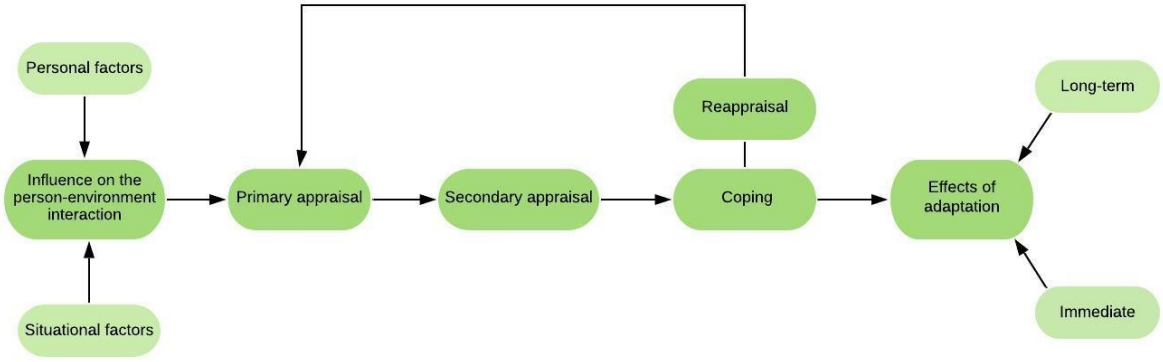

Figure 2. An overview of a transactional model based on Lazarus' and Folkman's (1984) cognitive theory of stress.

1.1.1 Acute stress

Acute stress occurs when an individual experiences a stressful event (i.e., stressors), triggering a cascade of physiological effects. Physical body changes in response to stressors are denoted as "*allostasis*" by Sterling and Eyer (as cited by McEwen, 1998, p. 36). Different systems are involved in this response, such as the hypothalamic-pituitary-adrenocortical axis (HPA-axis) and the autonomic nervous system (ANS) (McEwen, 1998).

When exposed to a stressor, a stress signal is sent to the hypothalamus. This is the part of the brain responsible for emotional processing and operates as a command centre for communicating through the ANS to the other parts of the body. The ANS, controlling unconscious vital body functions, is composed of the parasympathetic nervous system (PNS) and sympathetic nervous system (SNS). The latter is responsible for activating the *flight-or-fight response* when subjected to stress. In this stress response, hormones are excreted by both the SNS and HPA-axis, respectively epinephrine and cortisol. This leads to freeing up energy sources and distribution of energy to body tissues that are involved in the stress response. This stress response mechanism enables the body to create an adaptive response to the stressor (Schneiderman et al., 2005; Sterling & Eyer, 1981).

Acute stress and stress, in general, have been defined by several researchers as distress. Originally, stress was differentiated in eustress ("good stress") and distress by Selye (as cited by Le Fevre et al., 2003) based on the degree of demands, with distress occurring when the demands do not match the body's capacity. Whether a stressor leads to eustress, distress, or the two combined, depends on the individual's interpretation of this stressor and his/her choice on how to respond to it. A review on both concepts stated that both terms are not often used in occupational stress models due to a shift in word usage in scientific literature, involving the use of stress and distress as equivalent terms (Le Fevre et al., 2003).

1.1.2 Chronic stress

Chronic stress can emerge after exposure to psychosocial stressors for a prolonged duration. However, it can even occur with the absence of the initial stressor (Poulsen et al., 2019). As explained in Section 1.1.1, stressful events lead to physiological adaptations (allostasis). However, these adaptations can eventually entail allostatic load (AL) in chronic or repeated exposure to environmental stressors. This includes the adverse effects on the body through maladjusted activity of the adaptive physiological systems (McEwen, 1998; McEwen & Stellar, 1993). The impaired regulation of these systems is generated by their inability to comply with the demands of environmental stressors (Karasek et al., 2010).

McEwen (1998) postulates three different types of responses in AL, namely a repeated stress response, malfunctioning in the elimination of allostatic activity when stress has subsided, and a lack of sufficient adaptive responses to the stressor. Such long-term maladjusted responses to chronic stress contribute to the onset of chronic diseases and can lead to overall poorer health (Juster et al., 2010; Karasek et al., 2010). Furthermore, chronic exposure to psychosocial stress can result in a “dissociation” in responses to acute stress. This is manifested as an impaired physiological response, simultaneously with an increased, subjective stress response to acute psychosocial stress. (Bloomfield et al., 2019).

To this day, the role of chronic stress in the onset of negative health conditions (e.g. cardiovascular diseases), has been widely researched. Despite the growing body of research, there is still no consistent evidence about the biological pathways of stress-related conditions (Kivimäki & Kawachi, 2015) and the relationship between individual characteristics (e.g. social-economic status and gender) and chronic stress effects on health (Spruill, 2010; Steptoe et al., 2019).

1.2 Stress at work

Following the definition provided by the World Health Organization (n.d.), work-related stress occurs as a response when employees do not have the necessary resources to comply with the demands presented at their workplace. Several studies (Backe et al., 2012; Stansfeld et al., 2012; Theorell et al., 2016) have elucidated the significant role of stressful working environments in the development of chronic diseases, and detrimental effects on health.

The complexity in psychosocial factors of work-related stress gave rise to the development of various theoretical models to identify stressors in the working environment and examine their effects on health. In scientific literature two theoretical models received special attention, being

Karasek and Theorell's Job Demand-Control (-Support) model and Siegrist's Effort-Reward Imbalance model. Throughout this thesis, the focus is primarily on the JDC model.

1.2.1 Theoretical models

Karasek's (1979) original JDC model focused on psychosocial work characteristics. It clarifies the interaction of two aspects of the working environment leading to psychological strain, being job demands and decision latitude. The latter consists of skill discretion and decision authority, and is often referred to as job control. Figure 3 (Karasek, 1979, p.288) summarises the four job types in the JDC model, each with a different combination of job demands and control. The JDC model predicts two interactions based on the following two hypotheses (Karasek, 1979).

On the one hand, there is the so-called strain hypothesis which implies that high demands with low control at work lead to high job strain. On the other hand, the model predicts a change in individual abilities, when demands and decision latitude are equivalent. This involves a development of new behaviour patterns and increased learning when both job demands and control are high, mentioned as "active jobs", in contrast to "passive jobs" with low demands and low control (Karasek, 1979; Karasek et al., 1998; Pelfrene et al., 2001).

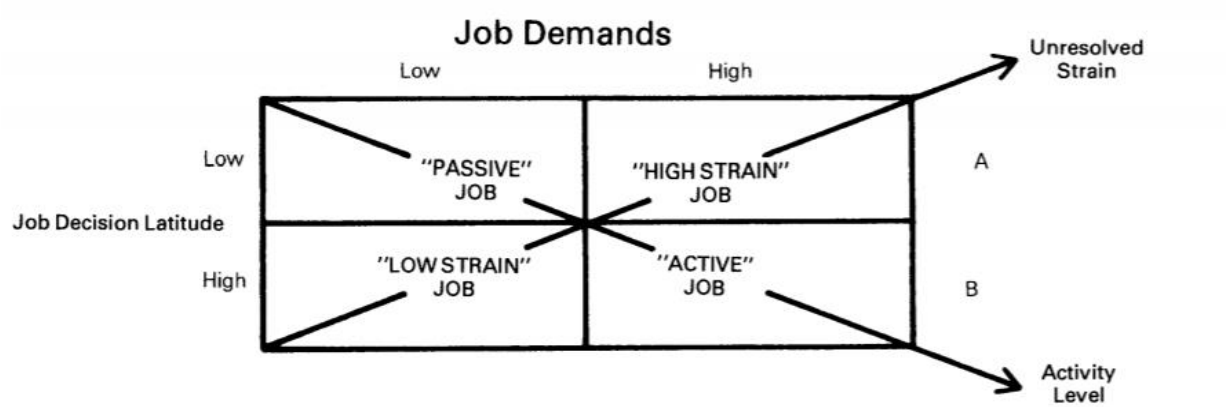

Figure 3. Job strain model. Reprinted from "Job demands, job decision latitude, and mental strain: Implications for job redesign" by R. Karasek, 1979*, Administrative science quarterly, 24*, p. 288. Copyright 1979 by JSTOR.

The JDC model (Karasek, 1979) was further elaborated by Johnson and Hall (1988) in which social support at work was added as an important factor in the association between work-related stress and the prevalence of cardiovascular diseases (CVD). As seen in the model of Johnson and Hall (Figure 4, Johnson & Hall, 1988, p.1336) a division of social support at work was made into isolated and collective conditions (respectively low and high social support), resulting in a modified pathway of job strain as seen in the JDC model (Johnson & Hall, 1988).

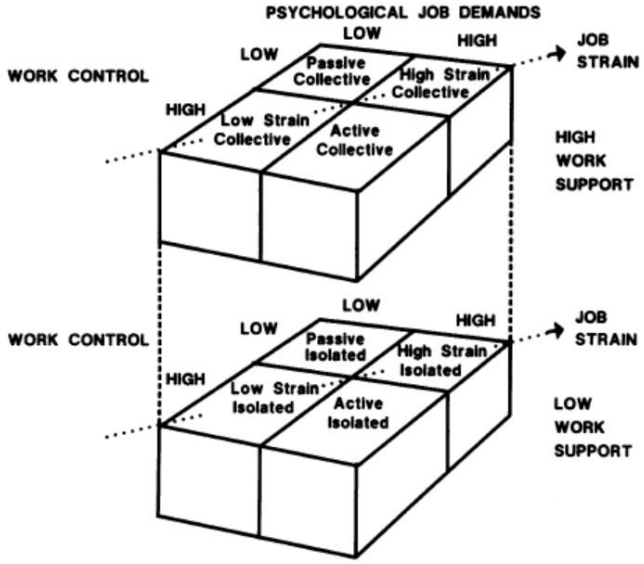

Figure 4. Demand-Control-Support Model. Reprinted from "Job Strain, Work Place Social Support, and Cardiovascular Disease: A Cross-Sectional Study of a Random Sample of the Swedish Working Population," by Johnson and Hall, 1988, American Journal of Public Health, 78, p.1336. Copyright 2014 by ResearchGate.

Finally, this led to the Job Demand-Control-Support model described by Karasek and Theorell in 1990 (Pelfrene et al., 2001) which is frequently used in occupational stress research. Following the main prediction, also referred to as the iso-strain hypothesis, high demands, low control, and low social support at work lead to an increased risk for adverse health effects. Within this model, social support at work is seen as a buffer for the adverse effects of job strain (Johnson & Hall, 1988; Van der Doef & Maes, 1999).

Another important model is the ERI model constructed by Siegrist (1996). Similar to the JDCS model, it evaluates the effect of work-related stress on health. The model draws upon the concept of reciprocity as a key factor in the exchange of social transactions. Within this concept, an absence of reciprocity at work (high efforts with low rewards) is seen as an adverse working condition. This condition is perceived as stressful because it fails to answer to the expected reciprocity at work. Eventually, this will lead to mental distress with a chronic state of arousal and negative effects on health.

Figure 5 (Siegrist, 1996, p. 30) demonstrates this lack of reciprocity in terms of an imbalance in extrinsic (job demands) and intrinsic (coping behaviour) efforts, and corporate rewards. These rewards include money, esteem, and control over the own occupational role, also referred to as career opportunity and job security (Siegrist, 1996, 2009).

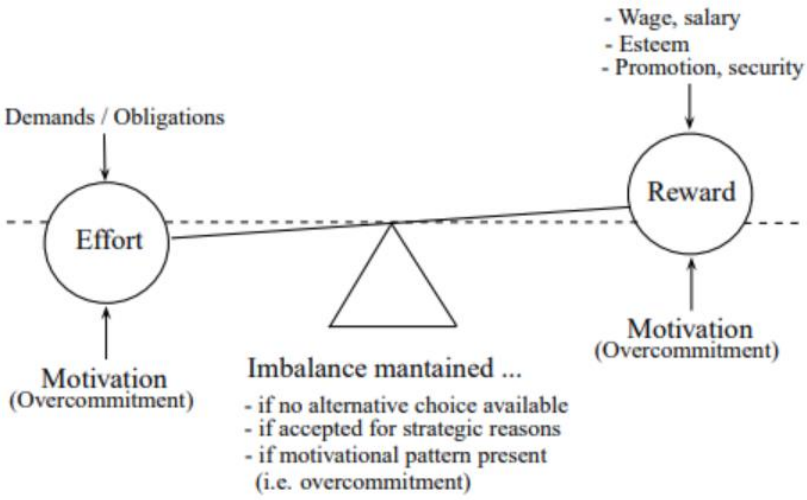

Figure 5. Schematic representation of the ERI-model. Reprinted from uniklinik-duesseldorf website, by J. Siegrist, 2012, retrieved from https://www.uniklinik-duesseldorf.de/fileadmin/Fuer-Patienten-und-Besucher/Kliniken-Zentren-Institute/Institute/Institut_fuer_Medizinische_Soziologie/Dateien/ERI/ERI-Website.pdf Copyright 2012 by University Düsseldorf

Besides working environment characteristics, the model also examines individual characteristics. These can play an important role in maintaining an (im)balance in efforts and rewards. The most important characteristic is overcommitment, described as a specific coping behaviour related to motivation to deal with demanding situations at work. Individuals with this personal trait commit excessively to work in response to their strong need for approval. A high level of overcommitment is associated with a higher risk for work-related stress effects, such as fatigue (Siegrist, 2009; Siegrist & Li, 2016). Other features can maintain an imbalance as well, such as the strategic choice to endure high-effort/low-reward conditions for a greater purpose (e.g. promotion) and dependency to the job. Possessing one of these characteristics increases the risk for experiencing a high-effort/low-reward condition (Siegrist, 2009).

1.2.2 Sources of stress at work

To gain insight in work-related psychosocial stress, it is essential to identify the workplace stressors involved. Examining these sources of work-related stress is challenging due to the variety in working conditions through differences within occupational fields and between individuals (Wentz et al., 2020). Working conditions in Europe have been monitored by

Eurofound (2017) with the European Working Conditions Survey (EWCS). The EWCS includes seven indices (Figure 6, Eurofound, 2017, p. 37) to objectively measure the various dimensions of job quality in working conditions. Every dimension consists of several indicators representing negative or positive properties of working conditions. These dimensions both independently and collectively influence the job quality and employees' health and well-being. Besides measuring the job quality, the EWCS also investigates the subjective assessment of one's own working life (Eurofound, 2017). Given the impact of adverse working conditions on health, it is essential to improve the job quality via organizational actions and policies for establishing a positive and supportive working environment (Eurofound, 2017; Theorell et al., 2016).

Figure 6. Overview of job quality indices and their indicators. Reprinted from "Sixth European Working Conditions Survey – Overview report", by Eurofound, 2017, p.37. Copyrighted 2017 by European Foundation for the Improvement of Living and Working Conditions.

1.2.3 Academic working environment

The job characteristics of academic staff members, being the target group in this study, differ from other occupations. These differences in working conditions may indicate dissimilarities in stress factors among employees in the academic working environment, compared to other working environments. A large scale research in the United Kingdom (Kinman & Wray, 2015) pointed out that employees in an academic working environment reported their work roles being characterised by high demands, role ambiguity, low support, and lack of effective management of change. In this group, a high level of job control was demonstrated as well, nevertheless, a reduction in the overall level of job control was observed over time. The results demonstrated that almost 80% of higher education members perceived their jobs as stressful. In addition to these results, a great deal of the employees in higher education reported higher levels of depression, anxiety and sleeping problems than in other occupations. Furthermore, over one-

third reported regularly neglecting their own needs to comply with job demands (poor work-life balance), as indicated by the same authors. A certain level of occupational stress is common in every profession, however, the increased level of work-related stress in academics is concerning (Kinman & Wray, 2015).

1.2.4 Effects of work-related stress

According to Lazarus and Folkman (1984), the overall effects of stress on health are influenced by both environmental stressors and individual vulnerability to these stressors. A similarity is seen in work-related stress, where its effects and health outcomes are influenced by individual characteristics (e.g. coping abilities) and the working environment (Baidwan et al., 2019; Stauder et al., 2018).

Cardiovascular diseases

Lagraauw et al. (2015) reported atherosclerosis as the main pathological pathway to CVD, described as a chronic condition and characterised by inflammation of the arterial walls due to retention of cholesterol (low-density lipoproteins). Exposure to stress leads to triggering the HPA-axis and SNS. These systems can affect the vessel walls (by elevating the heart rate and blood pressure), and contribute to the onset of atherosclerosis (Lagraauw et al., 2015). Furthermore, when exposed to chronic stressors, the immune system is suppressed, enhancing the inflammatory effects of stress hormones. This sustained inflammation can also contribute to the onset of CVD (Liu et al., 2017; Schneiderman et al., 2005).

Several theoretical models suggest a high risk of CVD in exposure to stressful working environments, characterised by low decision latitude, job strain (Karasek, 1981), iso-strain (Johnson, 1988,1989) and an imbalance in efforts and received rewards (Siegrist, 1990). This association is supported by results of various studies suggesting an association of psychosocial stress at work with CVD (Backe, et al., 2012; Kivimäki & Kawachi, 2015; Theorell et al., 2016). Work-related stress may be directly related to CVD by inducing biological alterations. However, it can also influence these physiological changes, indirectly, by affecting health behaviours (Kivimäki & Kawachi, 2015).

The study of Lumley et al. (2014) also found an interactive relationship between chronic and momentary stress in the influence of work-related stress on cardiac reactivity among female managers. The results demonstrated a higher heart rate reactivity in momentary stress at work, among the participants experiencing high chronic work-related stress. Moreover, an increased heart rate in high momentary stress at work only occurred, when high chronic work stress was

experienced. These results suggest that experiencing chronic stress at work, results in a higher risk for adverse cardiovascular effects of momentary or acute stress (Lumley et al., 2014).

Musculoskeletal symptoms

Musculoskeletal disorders (MSDs) show the highest prevalence in work-related health problems, with almost 60% of the employees in the European Union reporting problems with work-related MSDs (de Kok et al., 2019). According to Lang et al. (2012), underlying exposure to psychosocial stressors at work contributes to the onset of MSDs through inducing an increase in muscle tension. Experiencing pain from these musculoskeletal problems results in a significantly lower health-related quality of life (McDonald et al., 2011).

Though a variety of studies have investigated the relationship between work-related stress and musculoskeletal symptoms, evidence supporting a robust causal relation still appears to be scarce. However, certain studies (Celik et al., 2018; Eltayeb et al., 2009; Jun et al., 2020) found a link between the working environment and musculoskeletal complaints. Findings from these studies support an association between work-related stress and musculoskeletal pain in the neck, shoulder and lower back. Furthermore, a multi-model approach of Herr et al. (2015) showed significant differences in this association, based on employees' work content and context (i.e., blue and white-collar workers). The risk for sick leave and work disability in employees experiencing musculoskeletal pain seems to be lowered in working environments with low job demands and high decision latitude (Mather et al., 2019).

Psychological distress

In addition to the physiological consequences, psychological well-being can be affected by work-related stress as well. Several studies found that adverse working environments are associated with affective distress, including depressive symptoms and feelings of anxiety (FOD WASO, 2007; Stansfeld et al., 2012; Levecque et al., 2017). Furthermore, the AL that comes with exposure to work stressors can lead to the rise of psychological fatigue (Sembajwe et al., 2012; Rose et al., 2017). Fatigue is also related to burnout, a psychological disorder defined as a combination of symptoms such as exhaustion, depersonalisation, and reduced or lack of accomplishment (Maslach & Leiter, 2016). Job strain is directly related to burnout and indirectly to depression, with burnout as a mediator in this relationship (Ahola and Hakanen, 2007).

Loss of productivity

Given the large number of scientific evidence supporting the negative effects of work-related stress on physiological and mental wellbeing, it is not surprising that this can also influence the productivity of employees. McDonald et al. (2011) described productivity loss as health-related sick leave (absenteeism), and lack of efficacy at work due to health-related impairment (presenteeism). Costs of reduced productivity impose an individual, organisational and societal burden.

Moreover, work-related stress negatively affects job performance, job satisfaction, commitment to the job, and turnover intentions, which in turn is associated with a greater loss of productivity (El Shikieri & Musa, 2012; Pereira et al., 2017; Thorsteinsson et al., 2014). A lower risk of reduced productivity is seen in working environments defined by high decision latitude and low job demands (Mather et al., 2019).

2. Methods

2.1 Research design

The pilot study concerned a non-experimental, quantitative research, using a prospective design. Data were obtained through three different measuring methods, being the baseline screening, the Empatica® wristband and the STRAW-app, including Ecological Momentary Assessments (EMA) and smartphone sensors. The purpose of this thesis was twofold. Firstly, it was examined how underlying exposure to psychosocial stress among employees in an academic working environment influences day-to-day stress situations at work. Secondly, adherence to the day-to-day EMA protocol was investigated.

2.2 Participants

The population of the pilot study consisted of Flemish employees with an office-based job at Ghent University. The homogenous sample of five eligible female employees was recruited, using convenience sampling. Besides university employment, there were other inclusion criteria such as Dutch-speaking, working at least 80% and owning an Android smartphone.

During the pilot study, cross-sectional data were received with a 100% return of the baseline screening (BS). The sociodemographic variables consisted of standard variables (age, gender, marital status, educational level, and country of birth), work-related variables, and variables about well-being and health behaviours.

2.3 Procedure

The study was conducted with the approval of the Committee for Medical Ethics (Appendix A and B). Eligible employees in the academic setting, applying for participation, received an email with information about the project and the procedure. The researcher contacted the participants via phone, to set a date and location for a face-to-face meeting. The participants were assured that all information is confidential and exclusively used in the interest of this research. A second email was sent to the participants communicating the date and time of the appointment, and further instructions. The timeline of the procedure is shown in Figure 10.

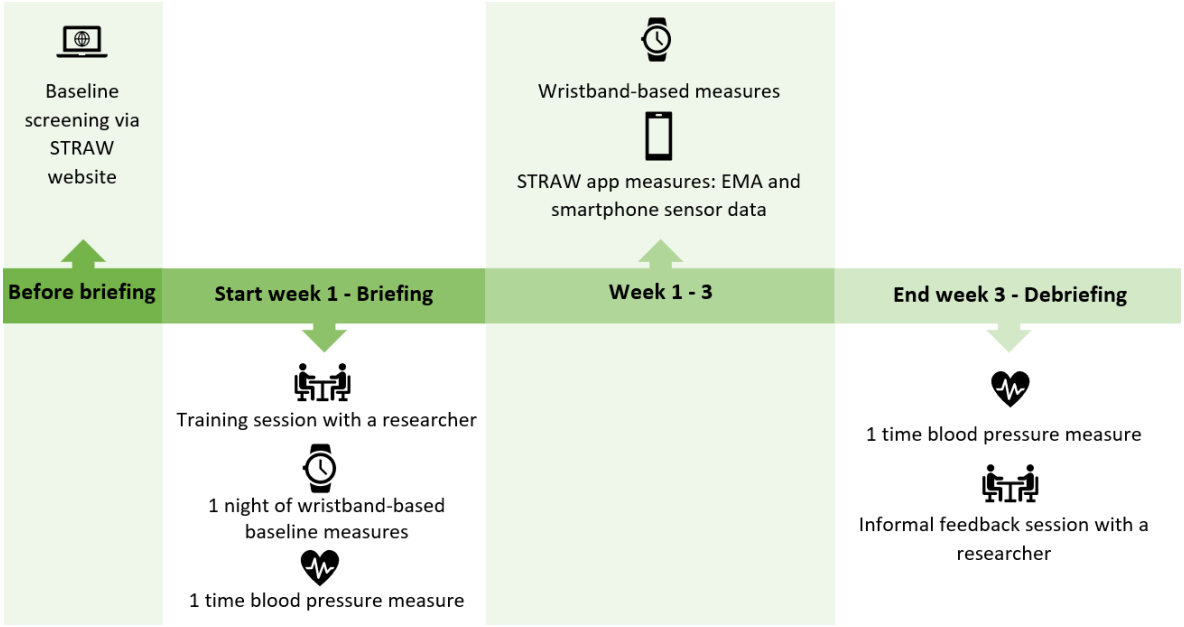

Figure 7. Timeline of data collection in the STRAW-Project and pilot study

For further continuation, all participants were requested to sign the informed consent by ticking off several boxes in the BS (Appendix C), via the link on the STRAW website, confirming their understanding of the information given and their consent to participate in the present study. They were also asked to install the E4 Manager on their smartphone for the transfer of data from the Empatica® wristband to the database, via another link on the same website mentioned above. The assigned individual username and password to link the data from the baseline screening and the EMA were also given in the email. Finally, they were invited to go through an informative document to become familiar with the data collection procedure.

At the start of the briefing moment, the participant was given more detailed information about the study from the researcher and was requested to sign a paper version of the informed consent. The participant's heart rate and blood pressure were monitored while wearing the wristband. During the briefing, the participant was informed about the different measuring methods used.

Throughout the preparation of the data collection the participant was guided by the researcher through the different steps of the procedure (e.g. installing the STRAW-app, the set-up of the app by inserting the start and end hour of their working day) and informed about the use of the wristband and STRAW-app, and the transfer of data from the app to the E4 manager. Participants were also requested to wear the wristband for one night before actual data collection, to check for malfunctions and provide baseline measurements.

In the following 15 working days, data were obtained via the Empatica® wristband and STRAW-app (EMA and smartphone sensor data). The app automatically displayed a morning questionnaire, daytime questionnaires (during the working hours), and an evening questionnaire. The daytime questionnaires popped up about every 90 minutes after the start of the working day, based on the start and end hour of the working day that was set during the briefing session. After their working day, participants could indicate that they were finished working, by which daytime questionnaires were stopped. When items from one of the three types of questionnaires were swiped away, a reminder appeared within approximately ten minutes. When the questionnaire was still unanswered, the questionnaire was automatically deleted. The participants could also choose the option that they would not work at the office, and so, no daytime or evening questionnaires appeared. The STRAW-app also automatically monitored smartphone sensor data during working days. Throughout 15 working days, data were continuously collected by the wristband during the hours the participants were awake. The participants were asked to daily transfer the data from the wristband to the E4 Manager. Data collection was finalised by a debriefing moment. Similarly to the briefing moment, the participant's heart rate and blood pressure were monitored while the Empatica® wristband was worn. Participants were also informally questioned about their experience regarding their participation.

2.4 Methods of data collection

Three different data collection methods were applied, involving a baseline screening, the STRAW-app (EMA and smartphone sensor data) and the Empatica® wristband. Two versions of a survey were composed, having a partial overlap of scales. The first version was used for the BS and provided for a cross-sectional dataset. The second version involved the EMA and was aimed for intermediate data collection, to acquire a longitudinal dataset. The scales, used in the BS and EMA, were selected by an appropriate level of validity, reliability, and relevance to the study. An overview of all scales and questionnaires are given in Appendix D.

2.3.1 Baseline screening

The BS was used for self-administered data collection. Participants completed the survey on LimeSurvey before starting data collection. The first section contained questions about general data, work-related information, and data related to health and wellbeing. This part was followed by a series of well-known and validated scales and questionnaires. They each measured a specific issue related to stress at work (e.g. working conditions, coping strategies, sleep quality, physical and mental health).

2.3.2 STRAW-app

Ecological Momentary Assessment

The EMA operated as an electronic diary within this study, and was used for repeated measures of perceived work-related stress. As stated by Shiffman et al. (2008), the EMA approach is characterised by an ecological and momentary dimension. By carrying out data collection in the participants' real-world environment, as they behave like in normal life, a generalisability of the results is achieved which is essential for the ecological dimension. The momentary aspect incorporates the reporting of real-time data on current individual behaviours and experiences (Shiffman et al., 2008). Research on stress among teachers, supported the ecological validity and sustainability of the EMA in an educational environment (McIntyre et al., 2016).

A survey (EMA) was developed based on a selection of items from existing and validated questionnaires. Several scales in the EMA were overlapping with the baseline survey, such as the JCQ. Through the smartphone application, the measuring moments were carried out every morning, every 90 minutes within the working hours, and every evening during 15 working days. This means that each participant had to fill in approximately 5 surveys throughout their working day. The EMA assessed experiences and thoughts of the participants concerning "*work environment risk factors, self-perceived stress outcomes, health-related behaviours, and activities*" (based on the STRAW-Project protocol paper, in progress).

Smartphone sensor data

Besides the EMAs, also smartphone sensor data were derived by the self-developed app. These unobtrusive objective measurements (e.g. location and communication) were used for better understanding of participants' working environment and were measured via the app. The data were later processed using an automated computer algorithm. Smartphone sensor data is commonly combined with the EMA approach (Bertz et al., 2017; Heron & Smyth, 2010).

2.3.3 Empatica® wristband

As psychosocial stress cannot be monitored directly, a device was used to measure the physiological responses to real-life stress. The Empatica® wristband (Figure 8, the STRAW-Project protocol paper, in progress) is an unobtrusive measuring device, that recently emerged into the research of work-related stress. The validity of the device was supported by the study of McCarthy et al. (2016), involving the comparison of data from the wristband with electrocardiogram data from a standard clinical device. The results showed consistency in the quality of data in both devices.

Figure 8. Empatica® wristband used in the study. Reprinted from " the STRAW-Project protocol paper, in progress". Copyrighted 2020 by STRAW-Project.

Participants were asked to wear the wristband on their non-dominant hand, on working days, during the hours they were awake. The wristband was used for objective registration of acceleration, electrodermal activity (galvanic skin response), skin temperature, heart rate, and heart rate variability. These registrations were daily transferred to the E4 Manager (Figure 9, the STRAW-Project protocol paper, in progress).

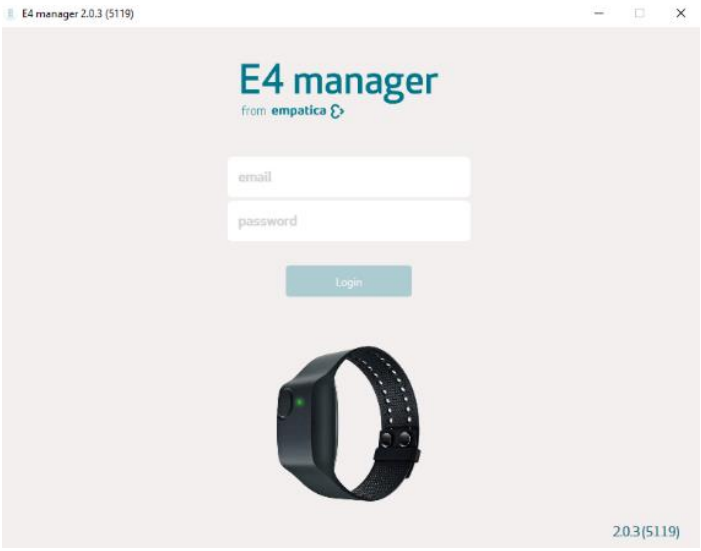

Figure 9. E4 manager. Reprinted from " the STRAW-Project protocol paper, in progress". Copyrighted 2020 by STRAW-Project.

Gjoreski et al. (2017) reported an improvement in the detection performance, when context information, obtained by the EMA, was included. These results indicated that additional information enabled the differentiation of psychological stress and other real-life factors with a similar effect on physiological arousal (Gjoreski et al., 2017). In this study, the data of EMAs and the Empatica® wristband provided for a combination of objective and subjective measurements of work-related stress. The combination of the EMA with the Empatica® wristband, has a great value for obtaining the comprehensive measurement of work-related stress.

2.4 Measures thesis

This thesis study researched two separate cases. Firstly, the relationship between underlying exposure and day-to-day experiences of work-related stress was examined. Secondly, the feasibility of the EMA protocol was explored by examining the adherence to the EMA protocol. Exclusively data from the baseline and EMA were used in this thesis.

Due to the large number of stress scales (Appendix E), only one questionnaire was selected to measure psychosocial work-related factors. The Job Content Questionnaire (JCQ) was used because it is based on a well-known theoretical stress model (JDCS model) and focuses on the context of rapidly alternating working conditions on a short-term level (Karasek et al, 1998). Furthermore, the JCQ is integrated in both the BS and EMA. Therefore, it was possible to make a comparison between underlying exposure to psychosocial stress at work and day-to-day experiences of work-related stress.

The JCQ, developed by Karasek (1998), was used to assess the participants working conditions for measuring underlying exposure to psychosocial stress at work. The questionnaire includes psychosocial job characteristics, such as psychological demands, decision latitude (job control), physical demands, job insecurity, and social support (Karasek et al., 1998). In this thesis, solely exposure to job strain and the three main dimensions were examined, being job demands (5 items), control (9 items), and social support (8 items). Social support (overall social support) consisted of two subscales, being supervisor support and support from colleagues. Perceptions of the JCQ dimensions were asked with two items per scale in each EMA, on a four-point Likert scale: (1) *completely disagree*, (2) *disagree*, (3) *agree*, (4) *completely agree*. All items were taken together within the corresponding dimension and mean scores were calculated for each dimension. For social support, mean scores were computed of the two subscales as well as the overall dimension. Several items needed to be reverse scored, with a higher score pointing out higher exposure (Choi, et al., 2009). For social support, a fifth option was offered (*I did not have*

any contact with my supervisor and *I did not have any contact with any colleague*), to prevent forcing participants to select an answer mismatching their situation. This option was recoded as 8 and handled as a user missing. Consequently, the mean values of 8 were excluded from analyses. Based on the research of Janssens et al. (2016) a demands/control (D/C) ratio was calculated to measure job strain, by dividing the sum of demands by the sum of control.

2.4 Statistical analyses

Statistical analyses were carried out in SPSS 26. The level of statistical significance was set at $P \leq 0.05$ and a confidence interval of 95%. A P-value ranging from $P > 0.05$ and $P < 0.1$ indicated a borderline significant effect. Firstly, descriptive analyses were used to describe the sociodemographic characteristics of the study sample at baseline. Furthermore, this thesis primarily presented the analytical protocol of the study for examining both research questions, without taking firm conclusions on the results due to the small sample size. The analytical protocol concerning the correlation will be applied in further research in the STRAW-Project. As for the analytical approach for adherence, this is specifically designed for the pilot study and this thesis, and will not be a main focus in the STRAW project.

2.6.1 Correlation

Random intercept models were carried out to examine an association between underlying exposure and day-to-day experience of psychosocial stress at work. This model was selected because of the non-independence of the repeated measures data. Additionally to the linear mixed models (LMM), spaghetti plots and box plots were constructed illustrating the distribution in data and allowing to detect possible patterns with time. This time variable was based on the weeks of data collection. A week was defined as a period from Monday until Friday, independently from the first day of data collection (e.g. when the briefing moment took place on Tuesday, the fifth day of data collection occurred on Monday of the second week).

2.6.2 Adherence

The adherence towards the overall EMA protocol and the morning and daytime EMAs was examined as well. Before performing statistical analyses, preliminary colour-coding was carried out in Excel. The completion time was influenced by the type of questionnaire, because of differences in the number of items in each specific condition. Accordingly, every type of questionnaire was characterised with a colour code, specifying the different conditions. In total, 10 colour codes (Table 1) were applied to the dataset. Five of these conditions (brown, yellow, orange, green, and blue) were of interest to this thesis.

Table 1. Overview of colour codes for specific conditions

Colour code	Specific condition
Grey	Testing purposes during briefing
Purple	Incomplete questionnaire
Brown*	Morning questionnaire discontinued because indication of *day off*
Red	Morning questionnaire completed later because *not yet at the office*
Yellow*	Morning questionnaire, without a stressful event, completed
Orange*	Morning questionnaire, with a stressful event, completed
Green*	Daytime questionnaire, without a stressful event, completed
Blue*	Daytime questionnaire, with a stressful event, completed
Pink	Evening questionnaire, physical symptom(s), completed
White	Evening questionnaire, physical symptom(s), completed

Note: *The questionnaire conditions used for statistical analyses in this thesis.

Brown included discontinued morning questionnaires because the participants indicated it was their day off. *Yellow* and *orange* indicated a morning questionnaire without and with stressful events. *Blue* and *green* was used for daytime questionnaires with and without stressful events. In addition to these conditions, *red* demonstrated morning EMAs completed at a later moment because the participant responded *no* to the question 'Are you at work yet?'. This only appeared twice in the data and was not included in analyses.

Both the morning and daytime questionnaires differed in number of items depending on the occurrence of a stressful event. When a participant reported a stressful event in the questionnaires seven extra questions appeared. In contrast to only two extra questions when there was no stressful event. Also, the length of the morning questionnaires differed because of a fluctuation in the number of items from the Positive And Negative Affect Schedule (due to technical issues).

The Excel data set was transferred to SPSS 26 for statistical analyses. Based on the indicator, analyses were carried out within a short or long format. Descriptive statistics were used to examine the adherence towards the day-to-day EMA protocol. Additionally, a non-parametric Spearman correlation was applied to explore the association between underlying exposure to stress and adherence to the EMA-protocol. The results were merely descriptive given the exploratory disposition of the study, and the low number of participants resulting in a low statistical power.

3. Results

3.1 Sociodemographic variables

An extended description of the study sample (N=5) was obtained by descriptive statistics of the socio-demographic data at baseline. Due to the small sample size and the corresponding risk of skewed data, the median and interquartile range were given. Table 2 presents the basic characteristics of the sample size with five female participants. The median (range) age was 28,66 (24,8-34,7) years. All participants were born in Belgium, except for one participant. Besides one participant with a doctoral degree, all participants had attained a master's degree. All participants were married or living together without children, except for one participant who did not choose one of the proposed answer options.

Table 2. Basic socio-demographic characteristics of the study sample

General sociodemographic characteristics	N or Median (Total N=5)
Age	28,66
Age interval (years)	[24,80 – 34,70]
Gender	
Women	5
Men	0
Land of birth	
Belgium	4
Another country	1
Educational level	
High school	0
Bachelor's degree	0
Master's degree	4
PhD	1
Marital status	
Married or living together with children	0
Married or living together without children	4
In a relationship, not living together with children	0
In a relationship, not living together without children	0
Single with children	0
Single without children	0
Other*	1

*This participant described her marital status as being in a relationship, living together without children.

Work-related characteristics

As shown in Table 3, three participants described their job as working in a doctoral program. One participant reported to work 80% as a doctoral student and 20% as an educational assistant. One participant was working as a postdoctoral researcher. The median (range) months employed at the current university was 40,00 (25.00-86.00) months. One participant worked an exceptional 125 months at her current workplace. All participants had a fulltime work schedule and a median (range) of 38.00 (38.00-38.00) working hours per week, according to the employment contract. The median (range) actual hours worked per week was 38.00 (38.00 – 51.50) hours. Three of five participants worked as many hours as described in their work agreement.

Table 3. Basic socio-demographic characteristics of the study sample

Work-related sociodemographic characteristics	N or Median (Total N=5)
Months worked in the company	40
Work schedule	
Fulltime (100%)	5
99% - 80%	0
Working hours per week according to employment contract	38
38 hours	5
Actual hours worked per week	38
38 hours	3
48 hours	1
55 hours	1

3.2 Correlation

LMM examined associations between exposure to time and underlying work-related stress, and the experience of day-to-day stress situations at work. Two covariates were included in the statistical analyses, being time (days and weeks) and mean perceptions of JCQ dimensions. Because the study had an exploratory nature and did not include a real intervention, it was not intended to examine a time effect. However, time was still included as a covariate in the analyses, because of the repeated measures and complexity of the data. Perceptions of JCQ dimensions were measured at baseline and repeatedly in the EMAs.

The results revealed a lack of results for participant 1 and 3. This data shortage was caused by technical issues during data collection. Overall, all findings are based on a limited number of data due to the small sample size, resulting in low statistical power. Accordingly, they should be interpreted with considerable caution and are, therefore, rather tentative.

3.2.1 Descriptive statistics

Spaghetti plots

Descriptive statistics were used to visually assess an association between time and the day-to-day perceptions of the JCQ dimensions. Figure 10 to 15 illustrate the spaghetti plots for each

JCQ dimension, with the number of days on the X-axis (i.e., ideally 15 days) and the baseline mean perceptions on the Y-axis. Several days are not displayed on the X-axis because no data was obtained on these specific days (e.g. day 13 is missing in all spaghetti plots). Linearity in regression lines could not be observed from the plots. Assuming there is no significant effect of time over days, this variable is not further looked into and excluded from further analyses.

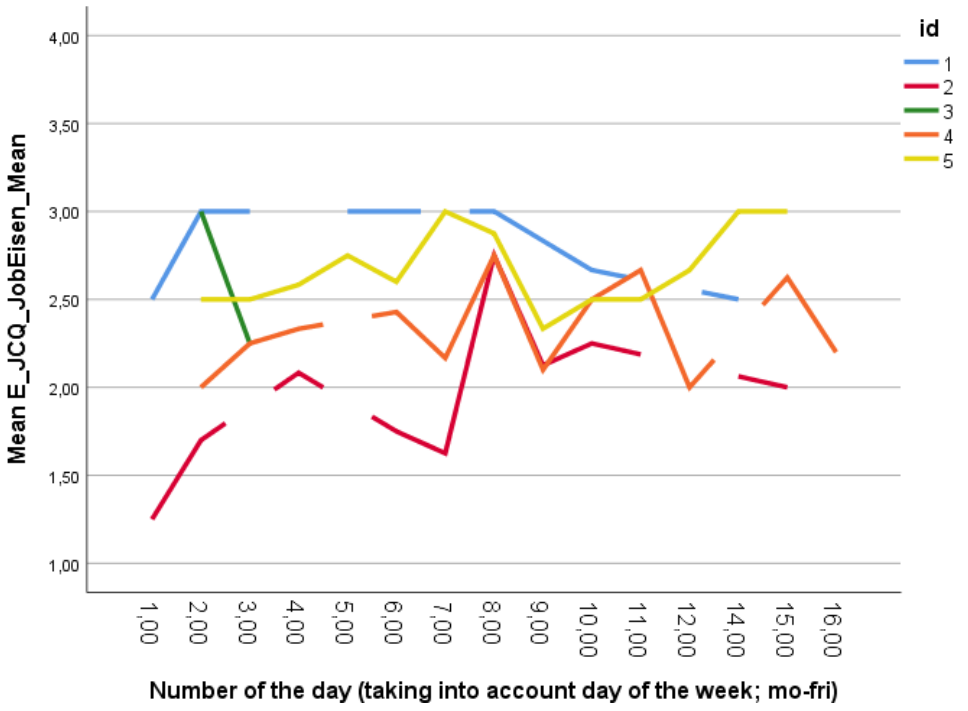

Figure 10. Visual representation of perceptions of job demands over different days of data collection

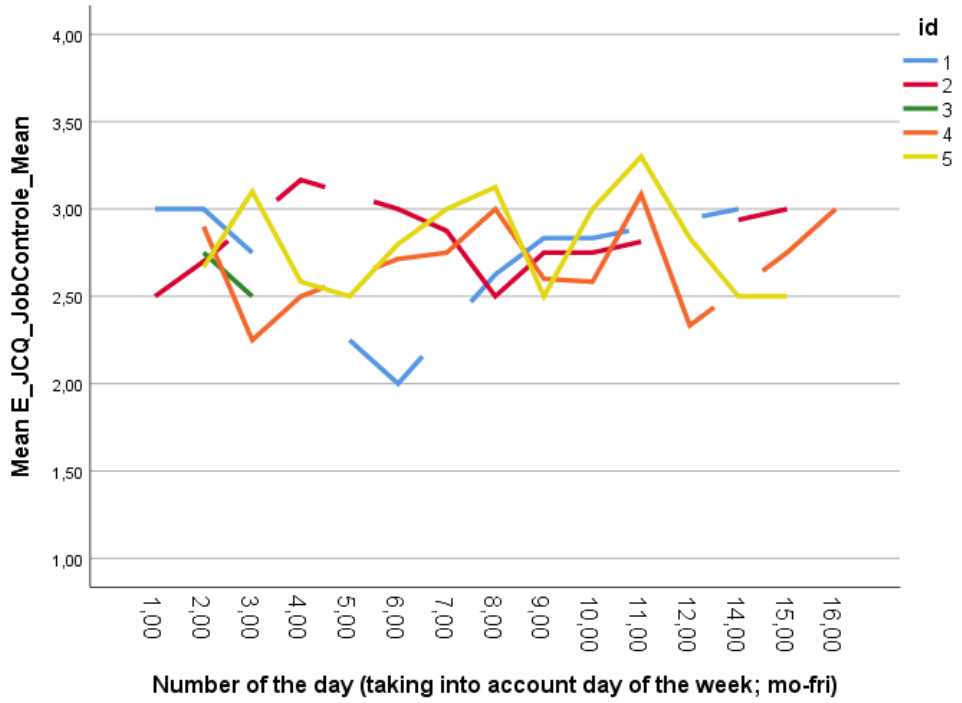

Figure 11. Visual representation of perceptions of job control over different days of data collection

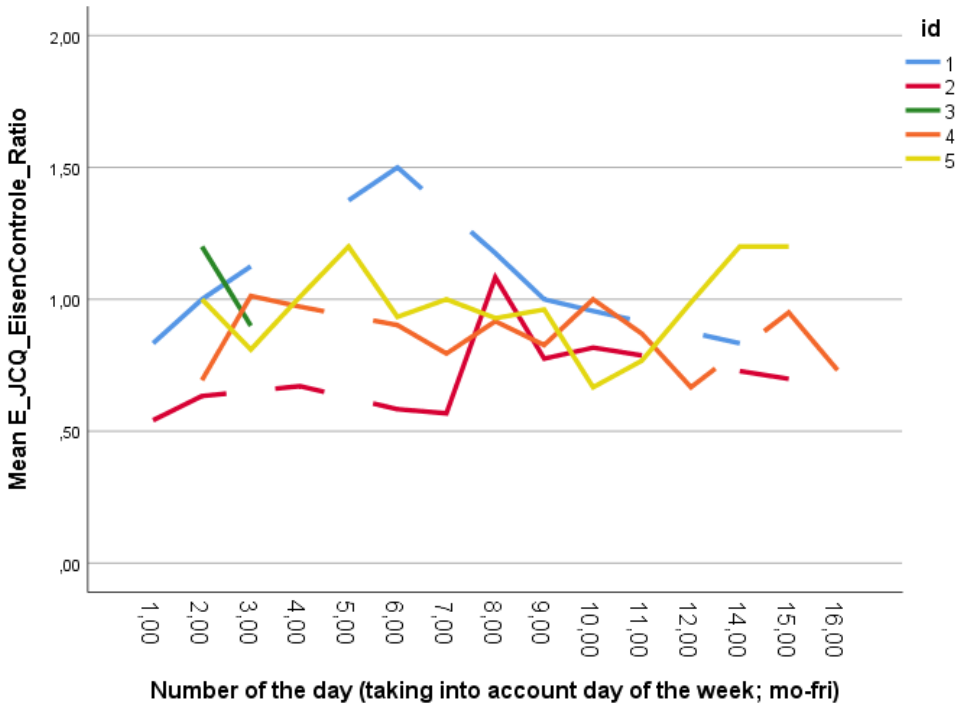

Figure 12. Visual representation of perceptions of job strain over different days of data collection

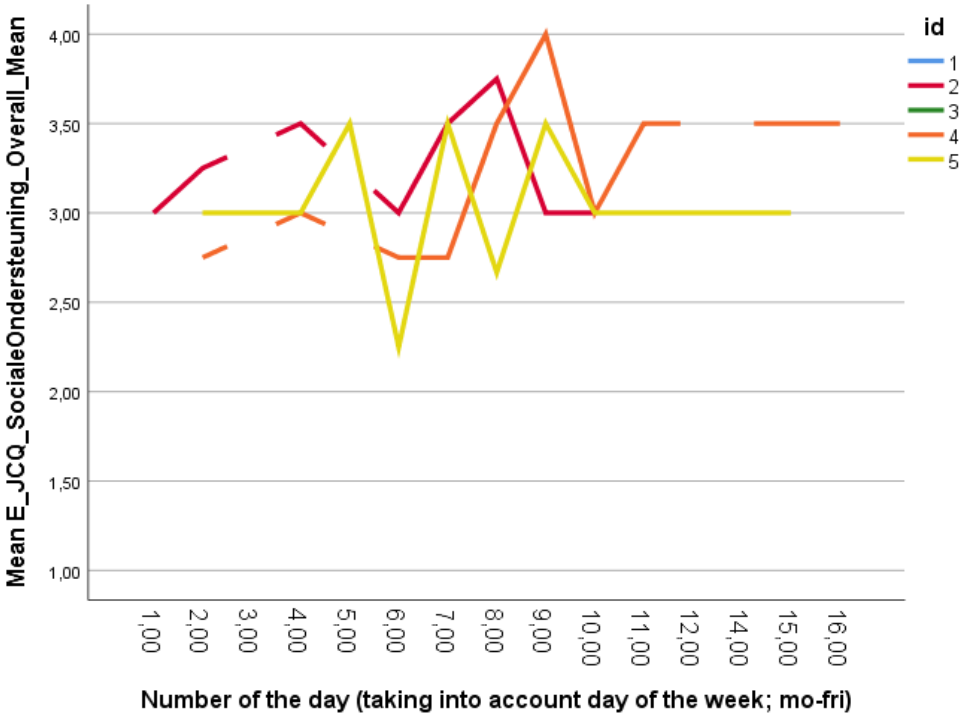

Figure 13. Visual representation of perceptions of overall social support over different days of data collection

Figure 14. Visual representation of social support (supervisor) over different days of data collection

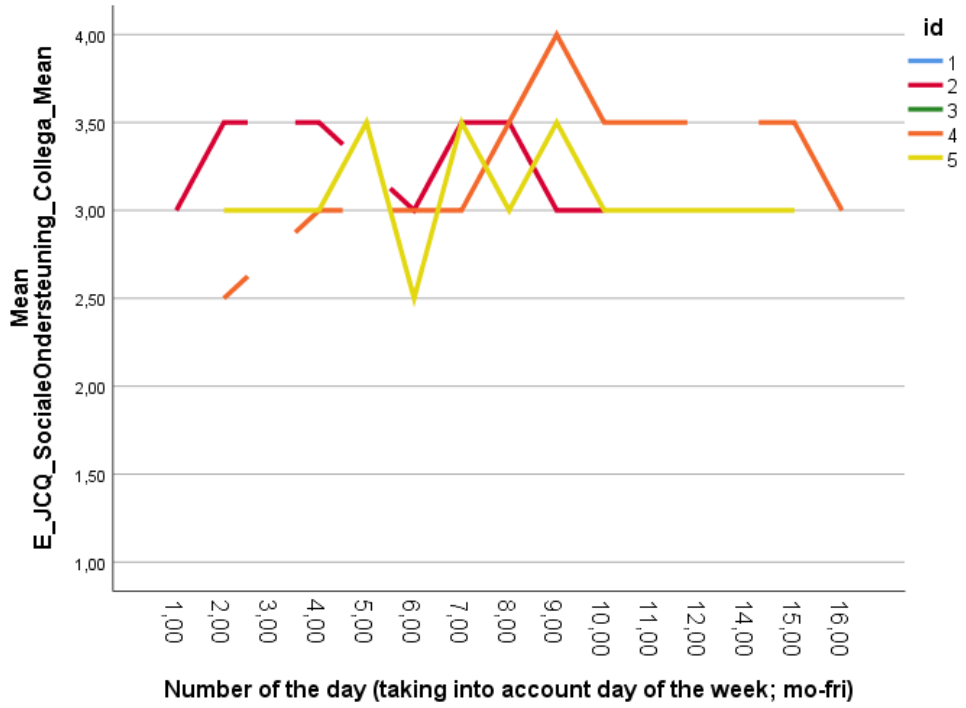

Figure 15. Visual representation of social support (colleagues) over different days of data collection

Boxplots

Descriptive statistics were conducted to show the distribution in data, for each week of data collection. For one participant, the collection was spread over four weeks due to organisational reasons (i.e., debriefing moment at a later moment). However, this fourth week was excluded from the statistical analyses. The median (Interquartile range) of JCQ perceptions is listed in Table 4.

Boxplots visualised the results, with the time variable on the X-axis and the JCQ dimension on the Y-axis, in which a higher value indicating a higher perception of the dimension. Despite the roughness of this data, it was decided to keep time as a continuous variable. Time was accordingly included as covariate in all further analyses. However, the findings should be interpreted with due care.

Table 4. Descriptive results of perceptions of JCQ dimensions over time (weeks)

Descriptive statistics

Week			*Job demands*	*Job control*	*Demands/ control ratio*	*Social support - Overall*	*Social support - Supervisor*	*Social support - Colleagues*
1	N	*Valid*	50	51	50	4	11	11
		Missing	16	15	16	62	55	55
	Median (Q1-Q3)		2.50 (2.00-2.50)	3.00 (2.50-3.00)	0.83 (0.67- 1.00)	3.00 (3.00-3.50)	3.00 (3.00-3.00)	3.00 (3.00-3.50)
	Minimum		1.00	1.50	0.29	2.75	3.00	2.50
	Maximum		3.00	3.50	2.00	3.50	3.00	3.50
2								
	N	*Valid*	67	66	66	12	16	16
		Missing	20	21	21	75	71	71
	Median (Q1-Q3)		2.50 (2.00-3.00)	3.00 (2.50-3.00)	0.86 (0.80-1.00)	3.00 (2.81-3.50)	3.00 (2.50-3.88)	3.25 (3.00-3.50)
	Minimum		1.00	2.00	0.40	2.25	2.00	2.50
	Maximum		3.50	3.50	1.50	4.00	4.00	4.00
3								
	N	*Valid*	26	27	25	1	7	7
		Missing	11	10	12	36	30	30
	Median (Q1-Q3)		2.50 (2.00-3.00)	3.00 (2.50-3.00)	0.83 (0.71-1.00)	3.00 (3.00-3.50)	3.00 (3.00-3.00)	3.00 (3.00-3.50)
	Minimum		1.50	2.00	0.43	3.00	3.00	3.00
	Maximum		3.50	4.00	1.25	3.50	3.00	3.50

Overall, there appears to be a low variance in median over weeks, with no variance in median job control and most variation in job strain. Figure 16 and 18 display a normal distribution in perceptions of job demands in week two and three and perceptions of job strain in week one. Outliers are presented for job demands, control, and job strain.

Based on figure 19 to 21, a normal distribution was found for support from colleagues in week two. As shown in figure 20, no boxplots were constructed for supervisor support in week 1 and 3 due to a shortage in data points within these weeks. It should be mentioned that a mean score of 8 on social support indicated that the participant had not seen her supervisor or did not work together with colleagues. These values were excluded from analyses.

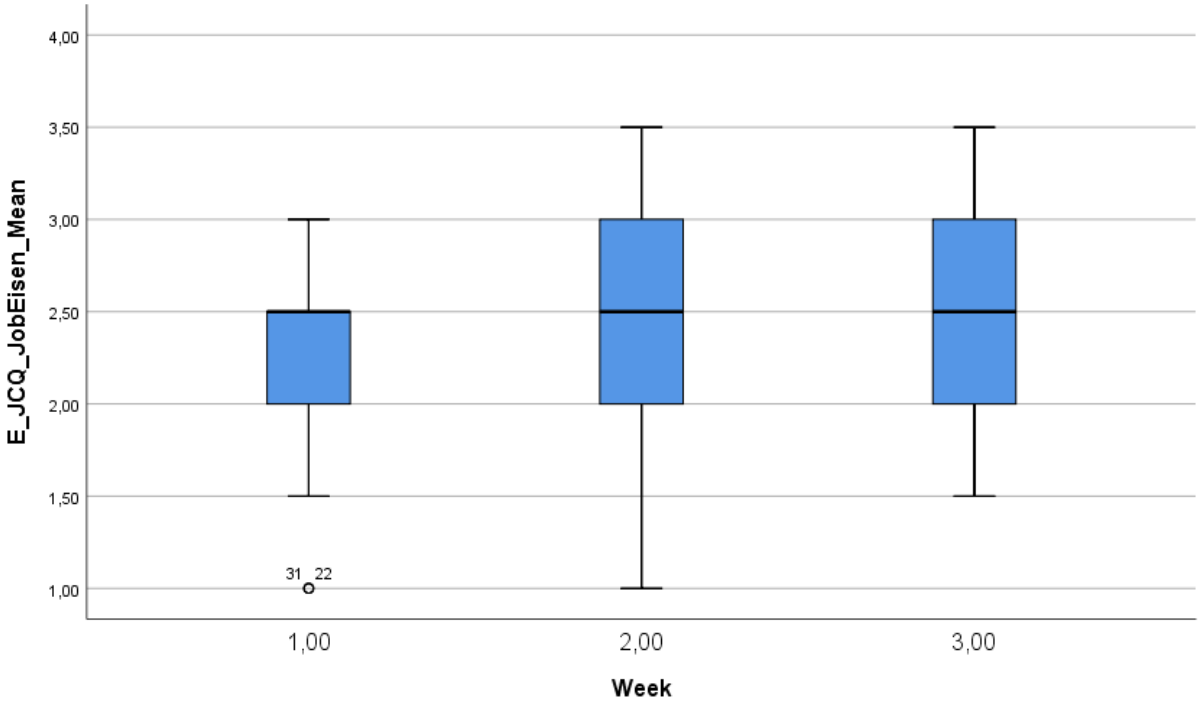

Figure 16. Boxplots – distribution of the perception of job demands per week

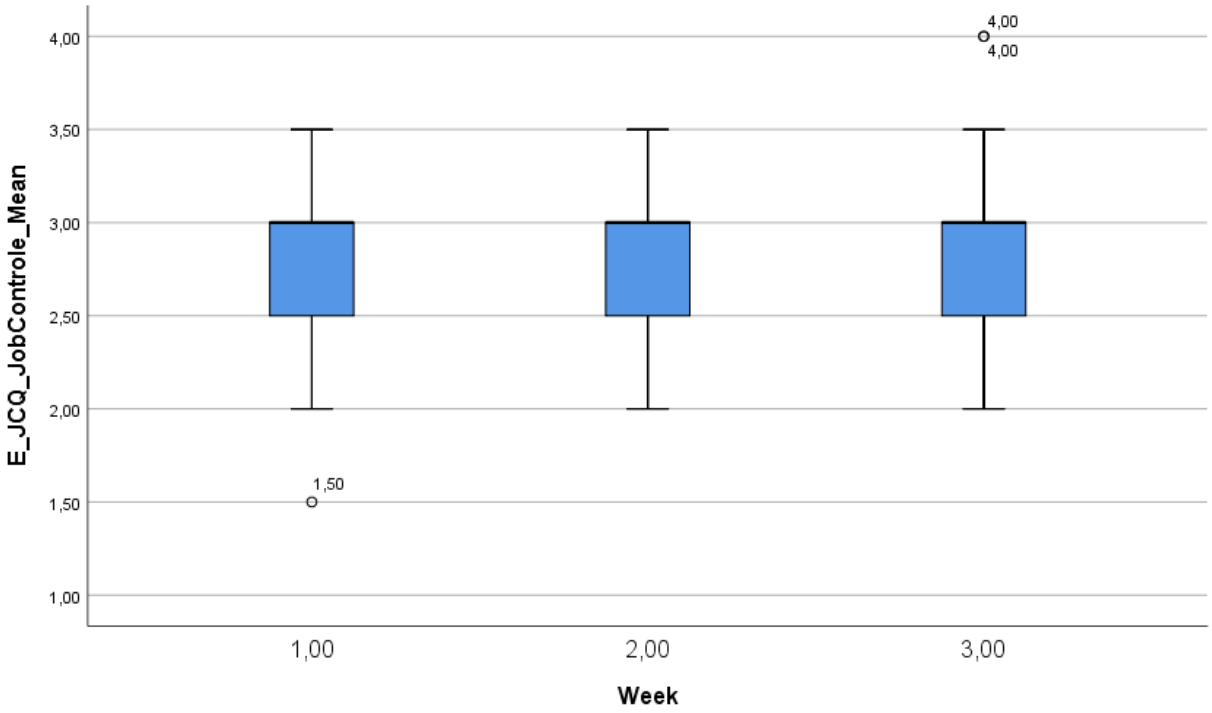

Figure 17. Boxplots – distribution of the perception of job control per week

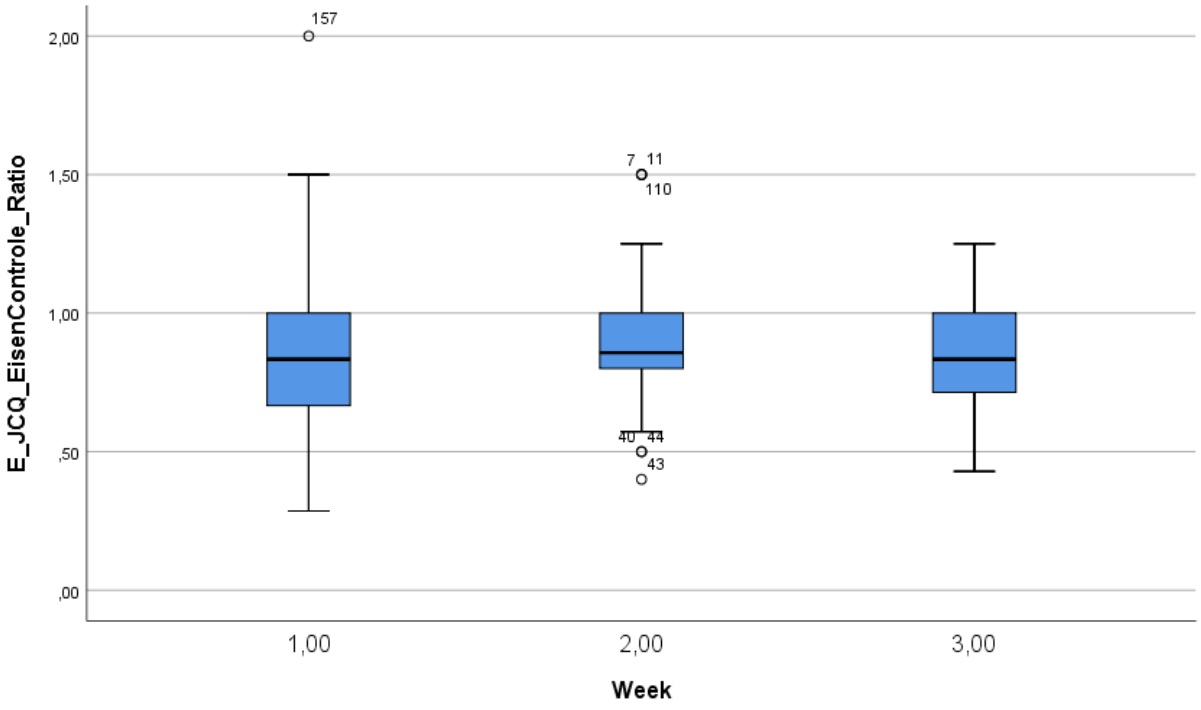

Figure 18. Boxplots – distribution of the perception of job strain per week

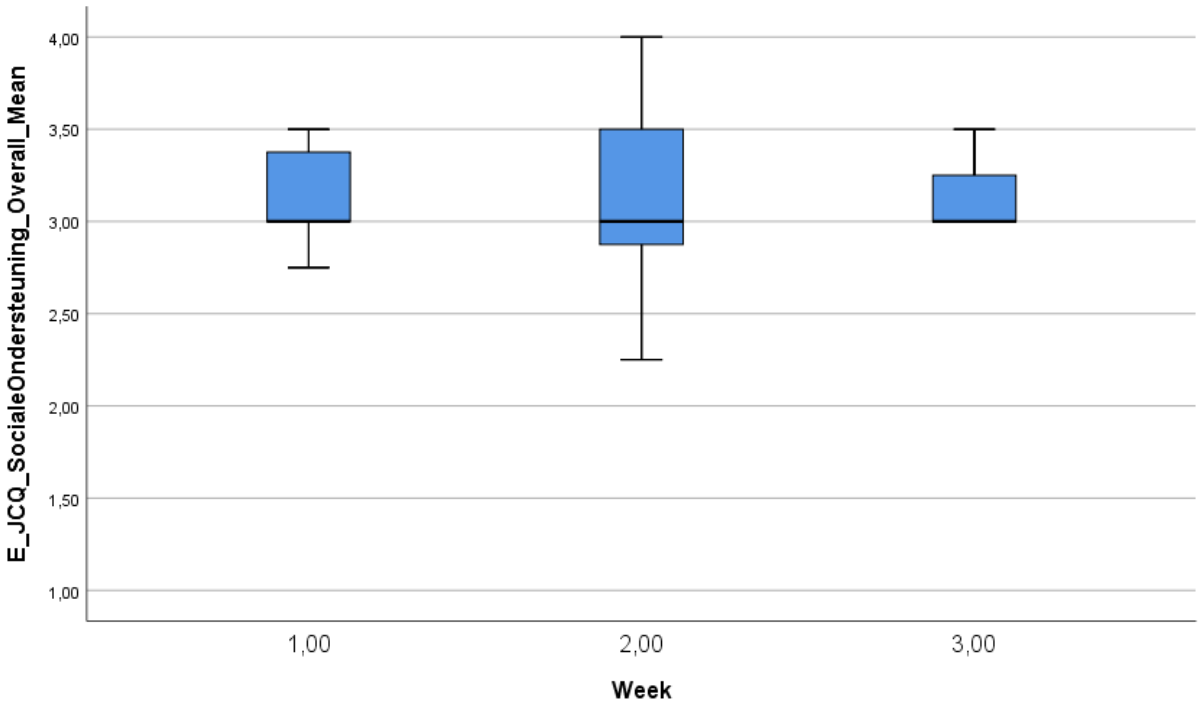

Figure 19. Boxplots – distribution of the perception of overall social support per week

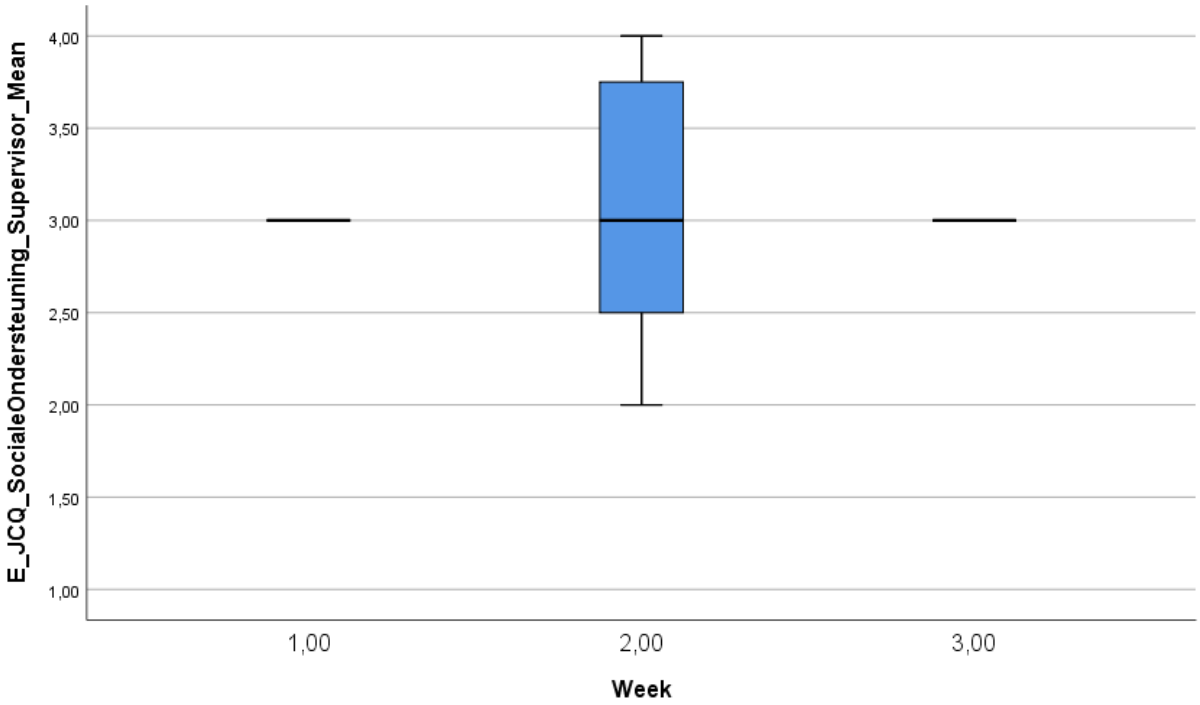

Figure 20. Boxplots – distribution of the perception of social support from supervisor per week

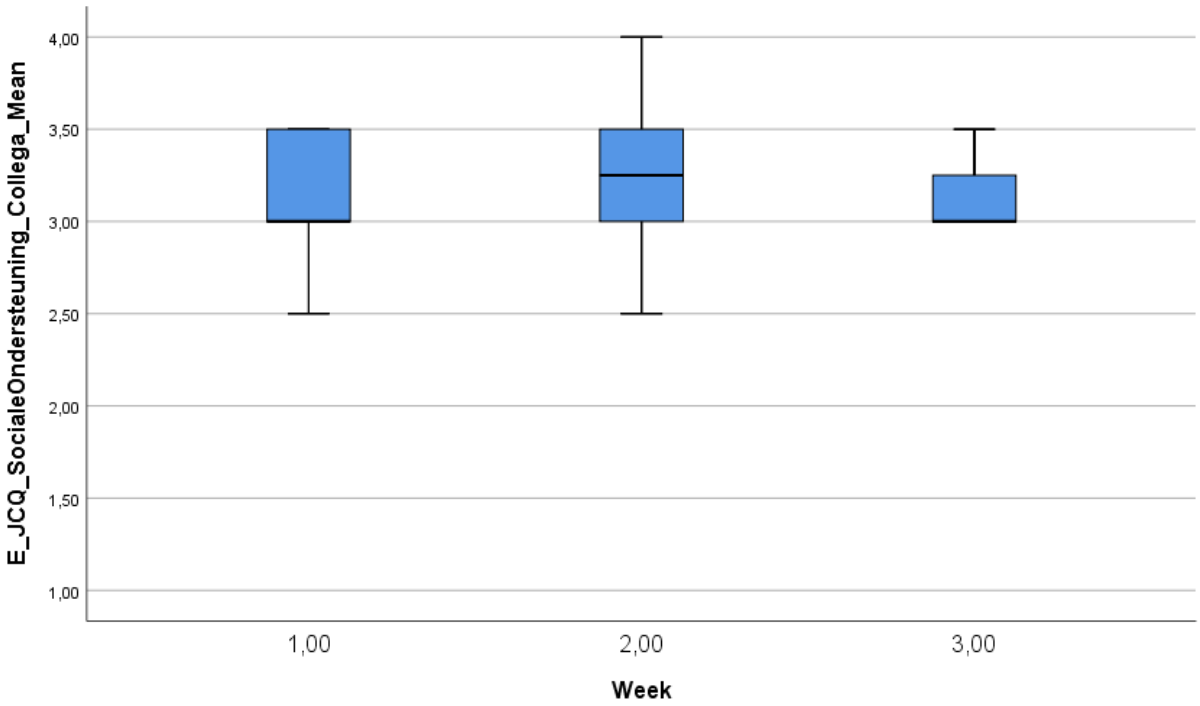

Figure 21. Boxplots – distribution of the perception of social support from colleagues per week

3.2.2 Main effect – Time

The first LMM examined the association between time and day-to-day perceptions of JCQ dimensions. The regression coefficient (β), 95% confidence intervals and P-values are shown in Table 5. A significant association was suggested between perceived job demands and time (β = 0.11, 95% CI = [0.01 - 0.21], P = 0.03) with no significant effects for the other JCQ dimensions.

Table 5. Results of multi-level analyses on correlation between EMA and Week

Estimates of fixed effects

Outcome variables	*Regression coefficients*	*Week*	
		95% CI	*P-values*
Job demands	0.11	[0.01 - 0.21]	0.03*
Job control	0.08	[-0.02 - 0.18]	0.12
Job strain	0.002	[-0.05 - 0.06]	0.93
Social Support - Overall	0.03	[-0.16 - 0.22]	0.73
Social support - Supervisor	0.07	[-0.54 - 0.68]	0.81
Social support - Colleagues	0.04	[-0.13 - 0.21]	0.66

*Correlation is significant at P ≤ 0.05.

3.2.3 Main effect – Baseline

The second LMM examined associations between baseline and day-to-day perceptions of JCQ dimensions. Baseline perceptions were treated as covariates. When carrying out the analyses, a warning regarding convergence problems was displayed for job control and social support (supervisor) due to the small sample size, which makes it difficult to get a correct estimate of the parameters. Analyses were still carried out, however, the findings should be observed with great caution. Based on the results summarised in Table 6, there were no significant associations for any of the dimensions.

Table 6. Multi-level analyses results of correlation between JCQ dimensions Baseline and EMA

Estimates of fixed effects

Outcome variables	*Regression coefficients*	*95% CI*	*P-values*
Job demands	0.09	[-0.95 - 1.13]	0.80
Job control***	-0.17	[-0.41 - 0.07]	0.16
Job strain	0.53	[-2.30 - 3.36]	0.57
Social Support - Overall	0.31	[-0.29 - 0.91]	0.23
Social support – Supervisor***	0.47	[-0.17 - 1.12]	0.14
Social support - Colleagues	0.31	[-0.50 - 1.11]	0.31

*** The final Hessian matrix is not positive definite although all convergence criteria are satisfied. The MIXED procedure continues despite this warning. Validity of subsequent results cannot be ascertained.

Scatterplots visualised possible associations between baseline (X-axis) and day-to-day perceptions of the JCQ dimensions (Y-axis). The Y-axis ranged from one to four based on the 4-point Likert scale, in which a higher value reflected a higher perception of the JCQ dimension.

Figure 22 hints to no association between baseline exposure to job demands and the day-to-day perceptions of demands. Participant 2 reported the lowest mean job demands at baseline, but the highest fluctuation throughout three weeks. Similar baseline perceptions were noticed in participant 1 and 3. Furthermore, a great difference in baseline mean demands was shown between participant 2 and 4.

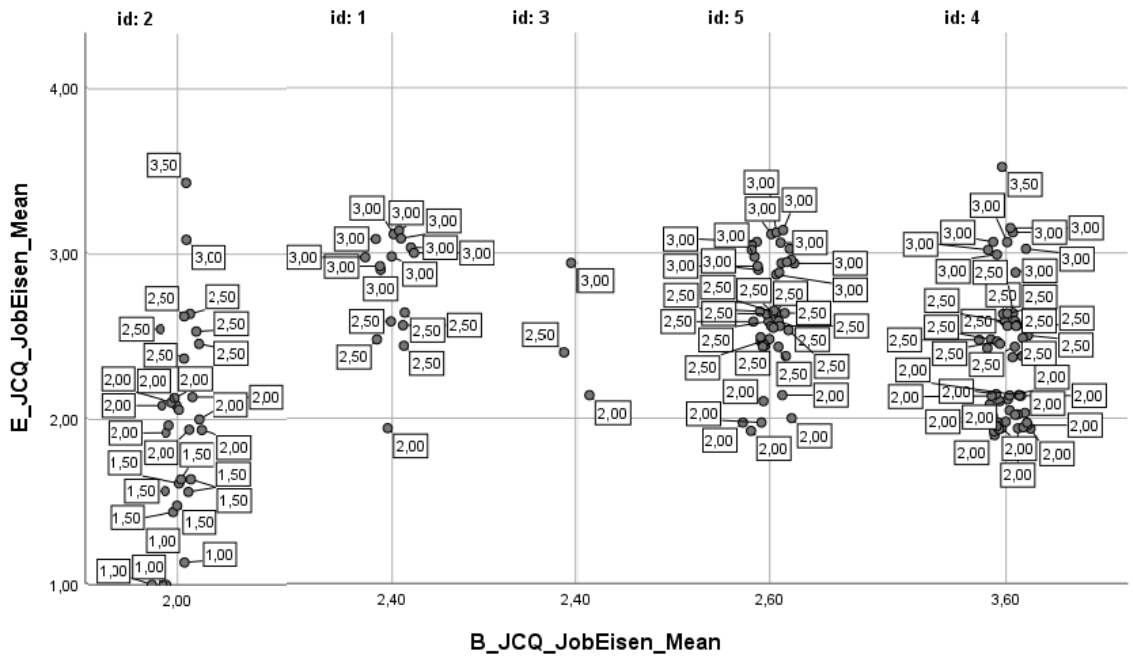

Figure 22. Job demands - Visual representation of the correlation between baseline and day-to-day perceptions

Figure 23 hints to no real correlation between baseline and day-to-day perceptions of job control. Participant 5 showed the lowest job control at baseline, however, the perceptions seem to fluctuate widely throughout three weeks. A great difference in baseline mean values can be noticed between participant 4 and 5.

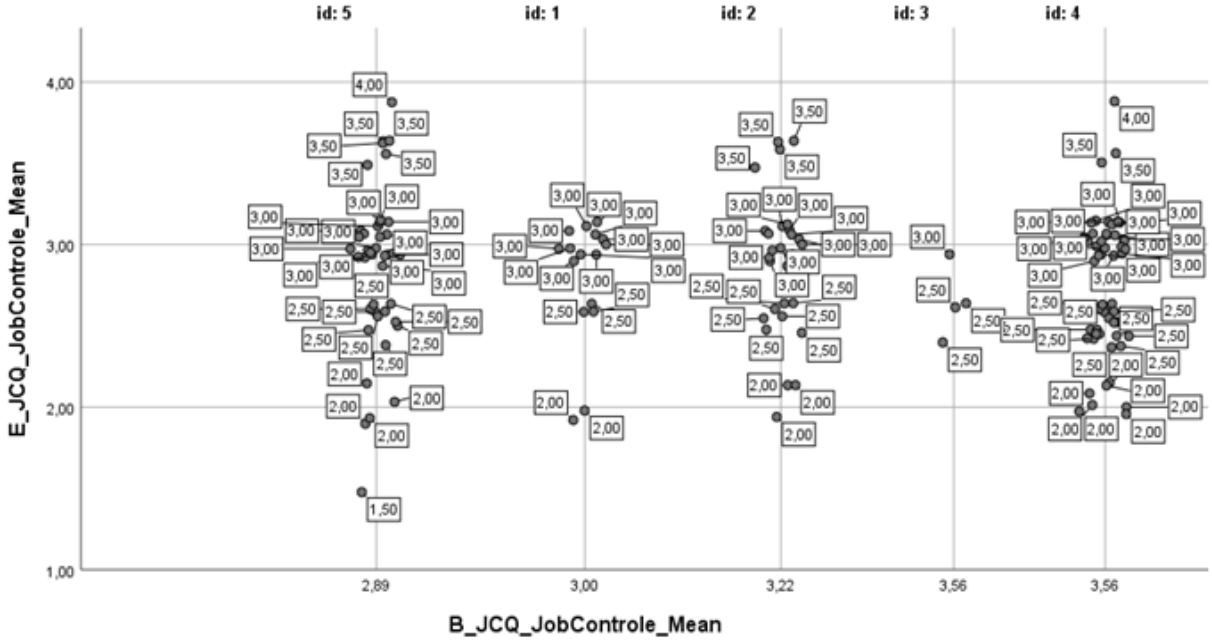

Figure 23. Job control - Visual representation of the correlation between baseline and day-to-day perceptions

The job strain plots (D/C ratio) in Figure 24, showed a different scale range than the other dimensions (from zero to two). A distinct correlation between baseline and EMA ratio could not be observed. The lowest demands/control ratio was shown for participant 4. When observing the range of baseline job strain, a great difference between participant 2 and 4 can be seen.

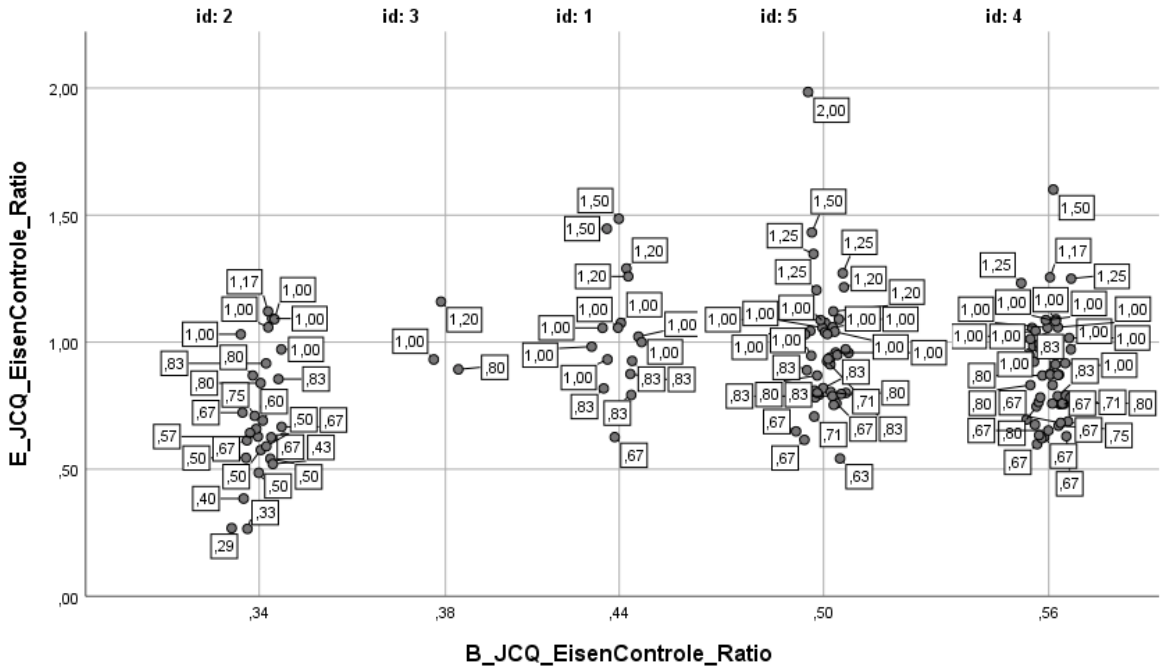

Figure 24. Job strain - Visual representation of the correlation between baseline and day-to-day perceptions

Figure 25 presents the scatterplots for the overall social support. Based on the plots, there seems to be no correlation between the baseline and EMA perceptions of overall social support. The lowest value can be noticed in participant 5. It should be noted that the data for social support are limited even without considering the missing data due to technical issues, which complicated their interpretation.

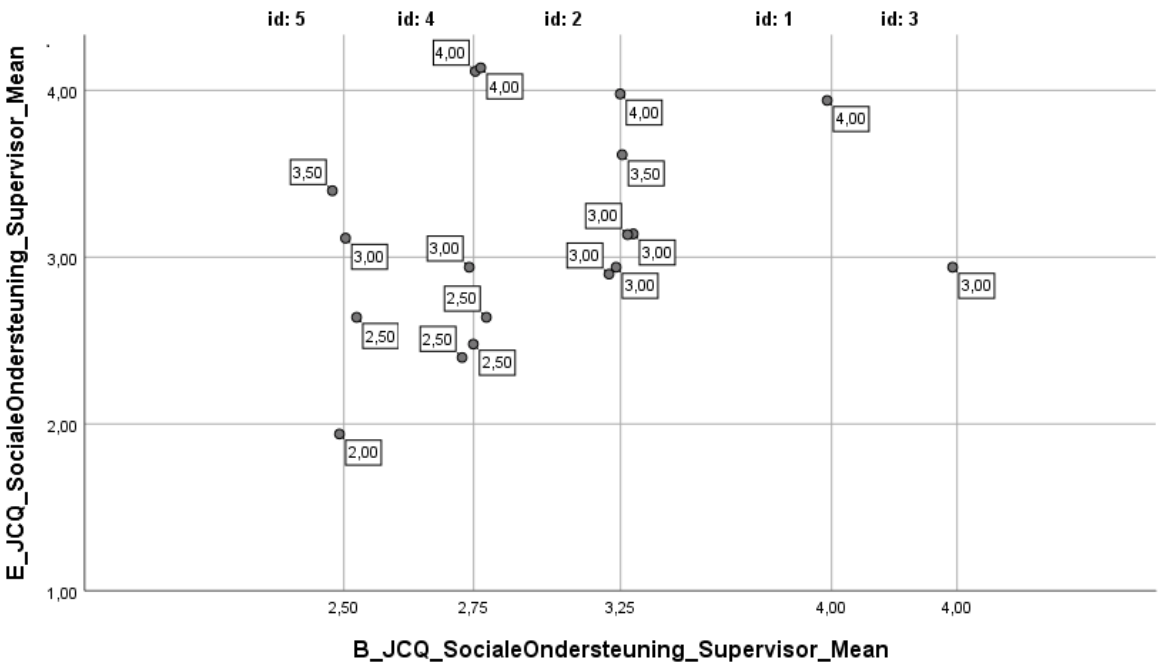

Figure 25. Overall social support - Visual representation of the correlation between baseline and day-to-day perceptions

Social support was divided into two variables, according to the source of support, received either from colleagues or her supervisor, respectively shown in Figure 26 and 27. The scatterplots suggested no obvious correlation between baseline and day-to-day perceptions for support from colleagues or supervisor however, highly fluctuating perceptions were seen for both variables. The lowest value was seen in participant 5 for support from supervisor and participant 4 for support from colleagues.

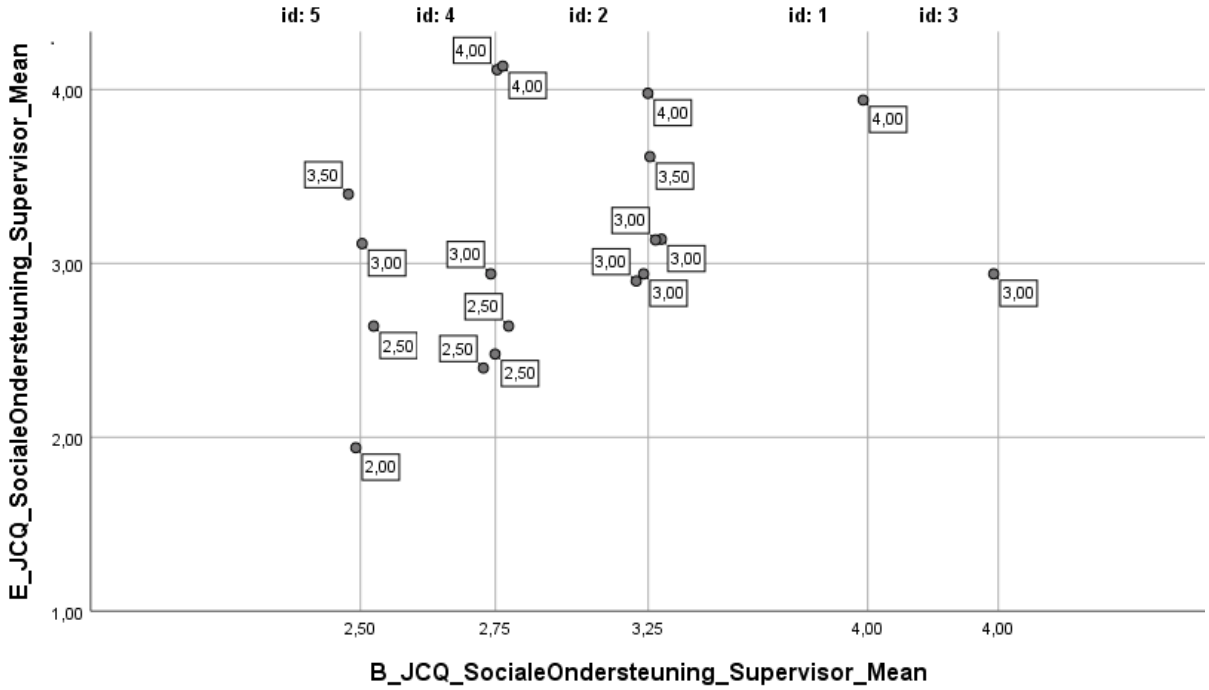

Figure 26. Support from supervisor - Visual representation of the correlation between baseline and day-to-day perceptions

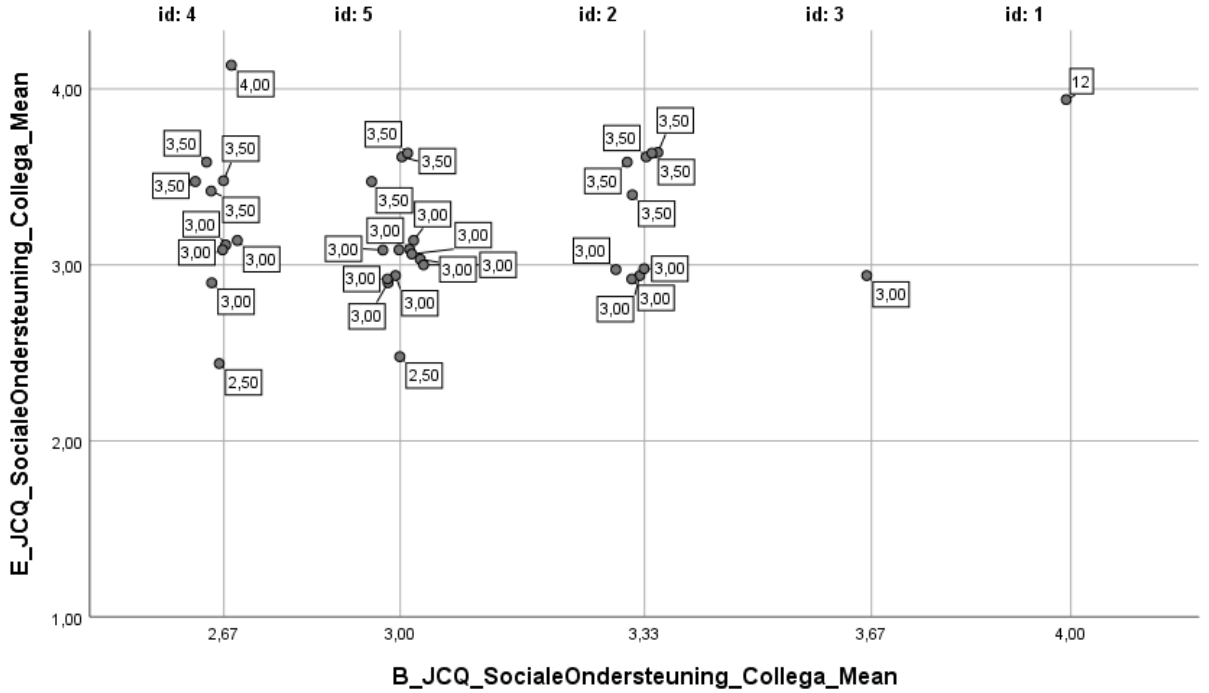

Figure 27. Support from colleagues - Visual representation of the correlation between baseline and day-to-day perceptions

3.2.4 Full factorial model

A full factorial LMM was performed in which time (weeks) and baseline perceptions of JCQ dimensions were included as covariates. The analysis was firstly focused on an interaction between time and baseline perceptions, and secondly on possible associations between exposure to the two covariates and day-to-day perceptions of JCQ dimensions. Results from the multi-level analysis are presented in Table 7 and 8. For some analyses, a warning of convergence problems appeared. These results should be interpreted with great caution.

A borderline significant association between baseline and day-to-day perceptions of support from colleagues (β = 1.51, 95% IC = [-0.27 - 3.29], P = 0.09), dependent of time was suggested as well as a borderline significant association between time and day-to-day perceptions of support from colleagues (β = 1.92, 95% IC = [-0.20 - 4.04], P = 0.08), dependent of baseline perceptions. Furthermore, there appeared to be a borderline significant interaction between baseline perceptions of support from colleagues and time (β = -0.63, 95% IC = [-1.34 - 0.08], P = 0.08).

Table 7. Results full factorial model – correlations between Week – EMA and Baseline – EMA

Estimates of fixed effects

Outcome variables	*Baseline*			*Week*		
	Regression coefficients	*95% CI*	*P-Value*	*Regression coefficients*	*95% CI*	*P-value*
Job demands	-0.05	[-1.01 - 0.91]	0.90	-0.06	[-0.54 - 0.42]	0.81
Job control***	-0.19	[-0.87 - 0.48]	0.56	0.13	[-0.95 - 1.21]	0.82
Job strain	1.06	[-1.40 - 3.52]	0.33	0.14	[-0.20 - 0.48]	0.42
Social Support - Overall	0.15	[-1.15 - 1.44]	0.82	-0.34	[-2.52 - 1.85]	0.76
Social support – Supervisor***	-0.32	[-2.43 - 1.78]	0.74	-1.42	[-4.88 - 2.05]	0.39
Social support - Colleagues	1.51	[-0.27 - 3.29]	0.09**	1.92	[-0.20 - 4.04]	0.08**

**Correlation is borderline significant at P ≤ 0.1.
*** The final Hessian matrix is not positive definite although all convergence criteria are satisfied. The MIXED procedure continues despite this warning. Validity of subsequent results cannot be ascertained.

Table 8. Results full factorial model – Interaction between Baseline and Week

Estimates of fixed effects

Outcome variables	*Interaction*		
	Regression coefficients	*95% CI*	*P-Value*
Job demands	0.06	[-0.11 - 0.23]	0.47
Job control***	-0.02	[-0.35 - 0.32]	0.93
Job strain	-0.28	[-0.97 - 0.40]	0.41
Social support – Overall	0.13	[-0.60 - 0.87]	0.71
Social support – Supervisor***	0.57	[-0.57 - 1.71]	0.30
Social support – Colleagues	-0,63	[-1.34 - 0.08]	0.08**

**Correlation is borderline significant at P ≤ 0.1.
*** The final Hessian matrix is not positive definite although all convergence criteria are satisfied. The MIXED procedure continues despite this warning. Validity of subsequent results cannot be ascertained.

3.2.5 Crude model

Finally, a crude LMM explored the independent associations between exposure to time and baseline perceptions of JCQ dimensions, and the day-to-day perceptions of JCQ dimensions, resulting in a multi-level analysis presented in Table 9. For some analyses, a warning of convergence problems was demonstrated, therefore it is advised to interpret these findings with great caution.

A significant association was suggested between baseline and day-to-day perceptions of supervisor support (β =0.68, 95% IC = [0.01 - 1.34], P =0.05) and a borderline significant association between baseline and day-to-day perceptions of job control (β = -0.23, 95% IC = [-0.47 - 0.02], P =0.07), independent of time. No other baseline effects showed significance. Additionally, there appeared to be a significant association between time and day-to-day perceptions of job demands (β =0.11, 95% IC = [0.01 - 0.21], P = 0.03), independent of the baseline perception of demands.

Table 9. Results random intercept model for association time – EMA and baseline – EMA

Estimates of fixed effects

Outcome variables	*Baseline*			*Week*		
	Regression coefficients	*95% IC*	*P-value*	*Regression coefficients*	*95% IC*	*P-value*
Job demands	0.06	[-0.98, 1.11]	0.85	0.11	[0.01, 0.21]	0.03*
Job control***	-0.23	[-0.47, 0.02]	0.07**	0.08	[-0.02, 0.18]	0.12
Demands/Control ratio	0.50	[-2.37, 3.37]	0.59	0.002	[-0.01, 0.01]	0.69
Social support - Overall	0.37	[-0.17, 0.90]	0.14	0.06	[-0.13, 0.25]	0.52
Social support - Supervisor***	0.68	[0.01, 1.34]	0.05*	0.30	[-0.30, 0.90]	0.31
Social support - Colleagues	0.32	[-0.45, 1.09]	0.31	0.05	[-0.12, 0.23]	0.517

*Correlation is significant at P ≤ 0.05.
**Correlation is borderline significant at P ≤ 0.1.
*** The final Hessian matrix is not positive definite although all convergence criteria are satisfied. The MIXED procedure continues despite this warning. Validity of subsequent results cannot be ascertained.

3.3 Adherence to EMA protocol

Descriptive statistics were performed to assess participants' adherence to the day-to-day EMA protocol, exploring different indicators. Furthermore, the association between underlying exposure to JCQ dimensions and adherence was examined. Participant 1 and 3 showed a significantly lower number of days, compared to the other participants, due to technical issues during data collection. Overall, the results are based on a limited amount of data points and should, therefore, be interpreted with care.

3.3.1 Entry completion

Days of participation

As shown in Figure 28, a bar chart was plotted to display the number of days each participant participated, throughout the 15 days of data collection. Based on the results, the number of participated days (Y-axis) varied strongly between participants (X-axis), with a minimum of two days, a maximum of 13 days, and a median (Q1-Q3) number of nine days (3.50-13.00).

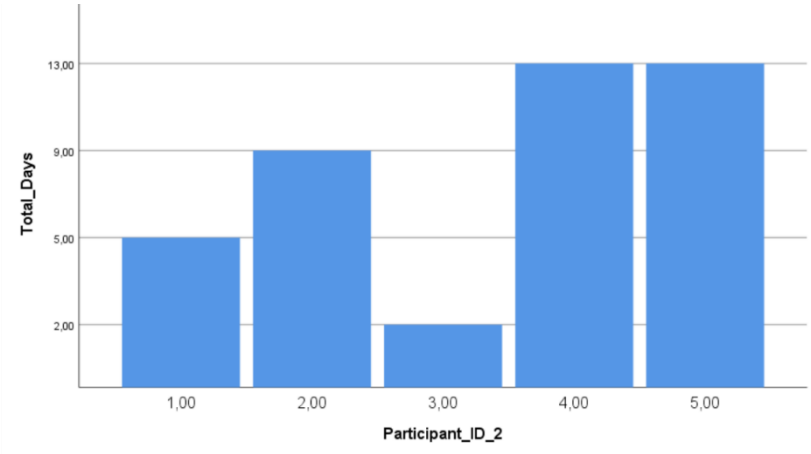

Figure 28. Distribution of total valid days of participation per participant

Number of completed EMAs

Figure 29 illustrates the number of completed EMAs per participant, throughout the three weeks of data collection. Based on the results, the total number of EMAs (Y-axis) varied greatly between participants (X-axis), with a median (Q1-Q3) number of 34.00 (8.00-58.50) EMAs and a total of 167 completed EMAs.

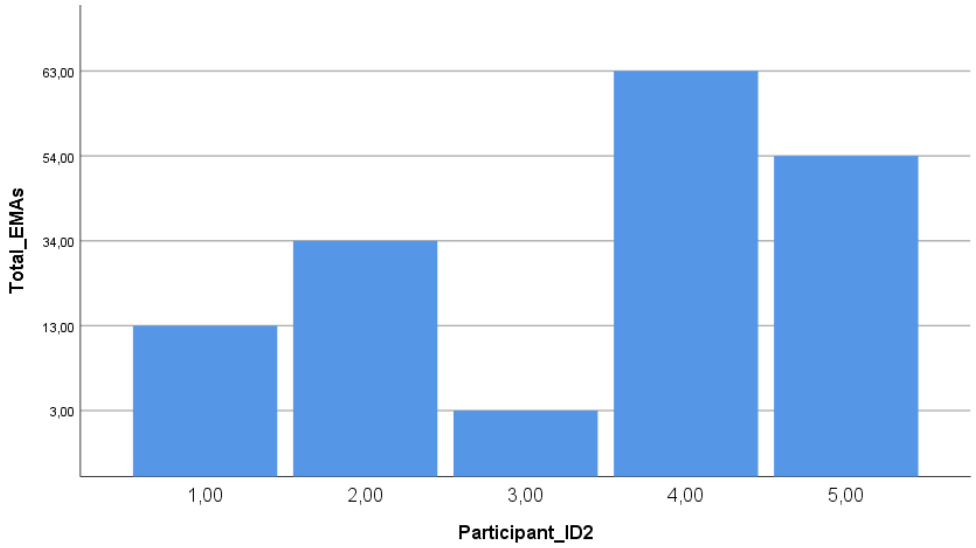

Figure 29. Distribution of total completed EMAs per participant

Figure 30 demonstrates the distribution of completed EMAs per day according to participant ID. This graph shows that the number of completed EMAs is highly fluctuating, both within and between participants. The bar chart also reflects the days without completed EMAs. However, it should be mentioned that the days that were reported as a *day off,* were not included in this bar chart.

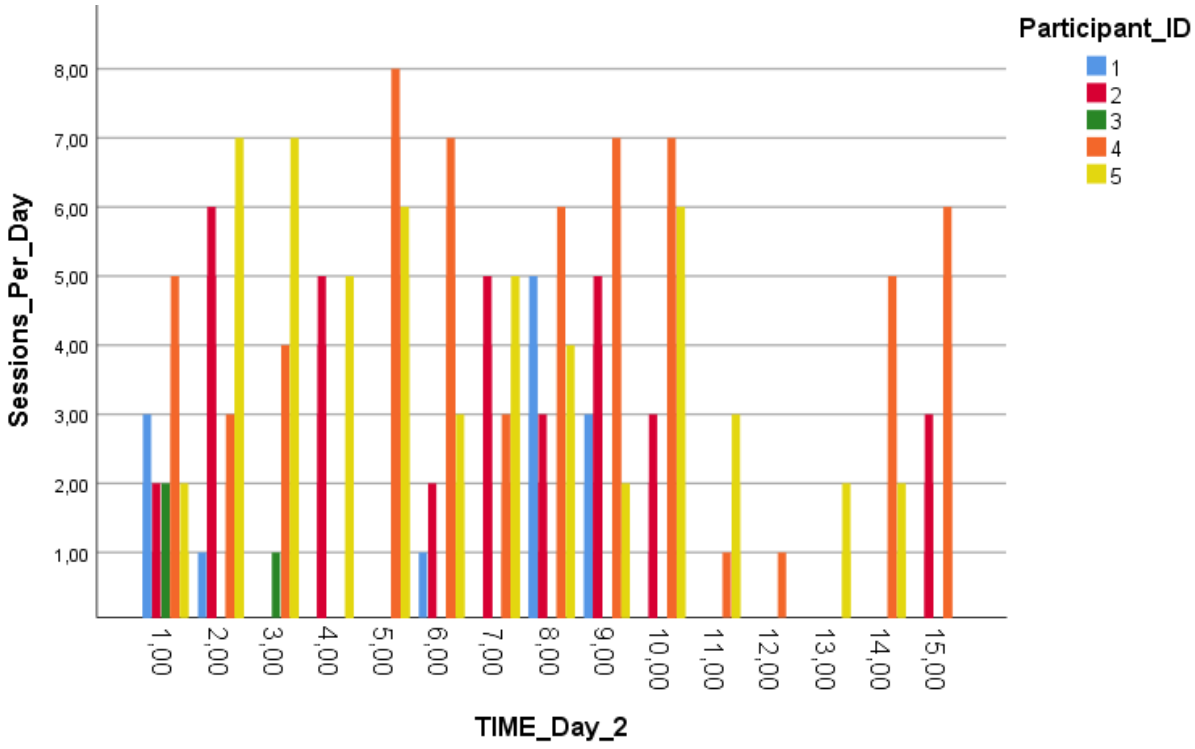

Figure 30. Distribution of completed EMAs per day based on participant ID

Figure 31 illustrates how many days each participant indicated as a *day off*, with the participant ID and number of valid days (days with one or more completed EMAs) on the X-axis and the number of days off on the Y-axis. This bar chart reflects how many of the missing days of each participant can be explained by a day off. Based on these results, there is a median (Q1-Q3) of 1 (0.50-4.50) day off. Participant 1 showed the lowest number of days off (zero) in contrast to participant 2 with the highest number of days off (six). Throughout the three weeks of data collection and for all participants, 11 days were reported in total.

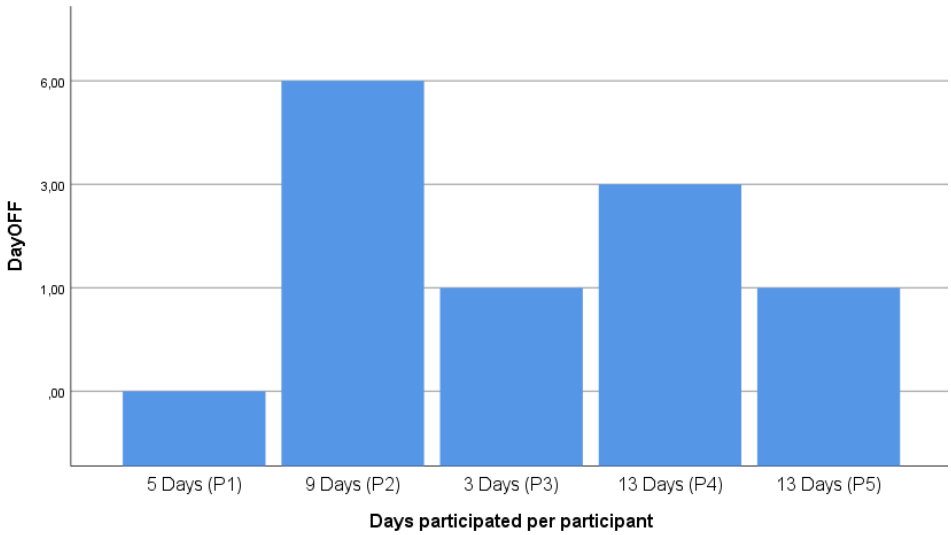

Figure 31. Distribution of days off per participant

3.3.2 Completion time and delay in response

The completion time and delay in response were examined to assess participants' adherence to the morning and daytime questionnaires of the EMA protocol. Due to a difference in the number of items, the morning and daytime questionnaires were categorised into different conditions, according to the occurrence of a stressful event.

Completion time

Figure 32 to 35 displays the data for completion time on the Y-axis in minutes down to milliseconds precision against the participant ID on the X-axis and visualises the distribution of completion time for all conditions. The descriptive results on the completion time of morning and daytime questionnaires are presented in Table 10 and 11.

Table 10. Descriptive statistics - Completion time of morning questionnaires with and without stressful events according to participant ID

Morning questionnaires

Condition		***Descriptive results***	***Participant ID***				
			1	*2*	*3*	*4*	*5*
Completion time	**Without stressful events**	Median (IQR)	-	0:01:36,31 (-)	-	0:00:58,67 (0:00:25,59)	0:01:32,02 (0:09:45.33)
		Minimum	-	0:01:07,61	-	0:00:39,02	0:00:59,25
		Maximum	-	0:01:45,58	-	0:01:30,27	0:11:26,39
	With stressful events	Median (IQR)	-	0:02:35,09 (-)	-	0:16:19,05 (-)	0:01:22,39 (-)
		Minimum	-	0:01:53,33	-	0:01:23,73	0:01:16,79
		Maximum	-	0:21:14,71	-	0:21:14,71	0:01:28,00

Table 11. Descriptive statistics - Completion time of daytime questionnaires with and without stressful events according to participant ID

Daytime questionnaires

Condition		***Descriptive results***	***Participant ID***				
			1	*2*	*3*	*4*	*5*
Completion time	**Without stressful events**	Median (IQR)	-	0:01:30,08 (0:59:49,11)	0:01:11,56 (-)	0:00:46,38 (0:00:15,63)	0:01:01,12 (0:00:39,73)
		Minimum	-	0:00:43,48	0:01:11,31	0:00:30,91	0:00:41,39
		Maximum	-	3:04:44,74	0:01:11,81	1:46:48,90	4:00:56,63
	With stressful events	Median (IQR)	0:01:06,56 (0:00:49,83)	0:02:27,24 (0:01:10,01)	-	0:01:25,60 (0:02:04,89)	0:01:03,82 (0:00:20,90)
		Minimum	0:00:50,44	0:01:29,52	-	0:01:11,31	0:00:52,74
		Maximum	0:02:13,20	0:04:06,36	-	0:08:41,03	0:01:18,47

Morning questionnaires – Without stressful events

Based on Figure 32, a great variability between participants' completion time can be observed. No boxplot was presented for participant 3 due to missing data points. Interpretation of the boxplot for participant 1 was not possible because only one data point was displayed. A wide range of time is expressed in participant 5, with a minimum of 0:00:59,25 and maximum of 0:11:26,39. Moreover, the values in the third quartile Q3 show a high dispersion. Due to the widespread data for participant 5, it is more difficult to interpret the other boxplots.

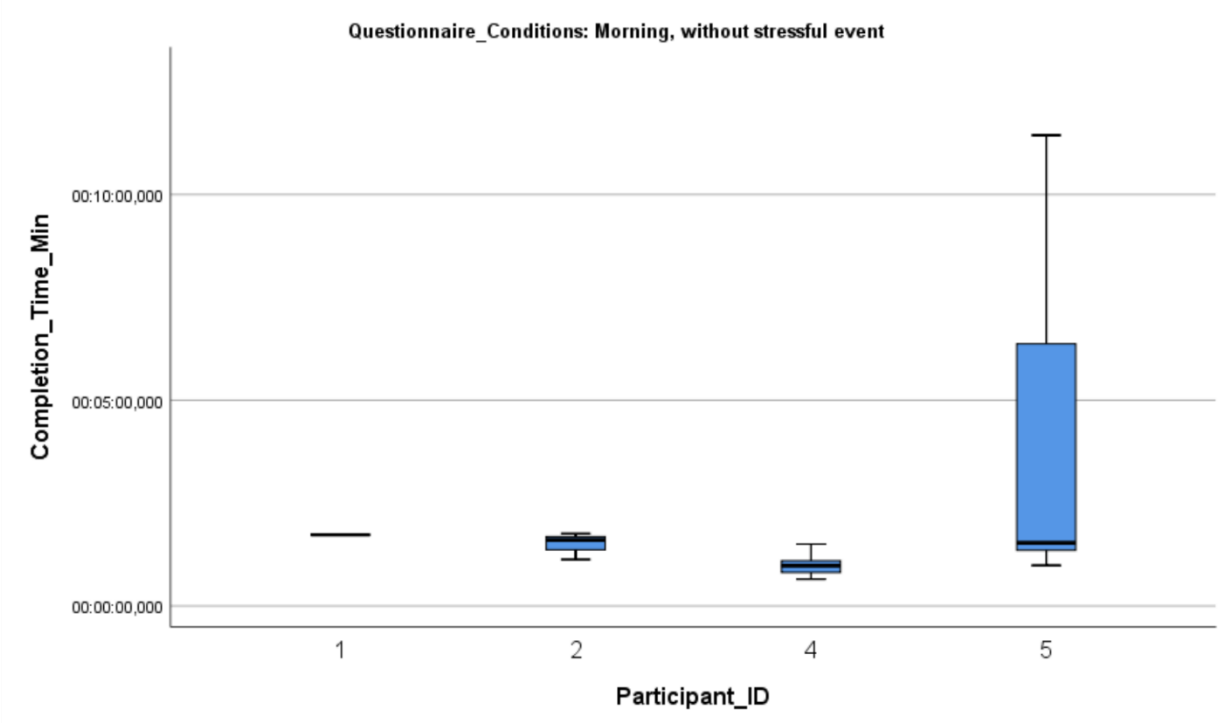

Figure 32. Boxplots - Distribution of completion time for morning questionnaires without stressful events

Morning questionnaires – With stressful events

Descriptive results were not listed for participant 1 and 3 in Table 10. A great contrast is seen between the lowest median in participant 5 (Median = 0:01:22,39) and the highest median in participant 4 (Median = 0:16:19,05). As seen in Figure 33, no boxplot could be constructed for participant 3. Interpretation of boxplots for participant 2 and 5 was not possible, due to a low number of data points. Based on the results, there is a great variability in the median across participants. The boxplot of participant 4, demonstrates a wide range of completion time (Min = 0:01:23,73, Max = 0:21:14,71), with great variation in Q1.

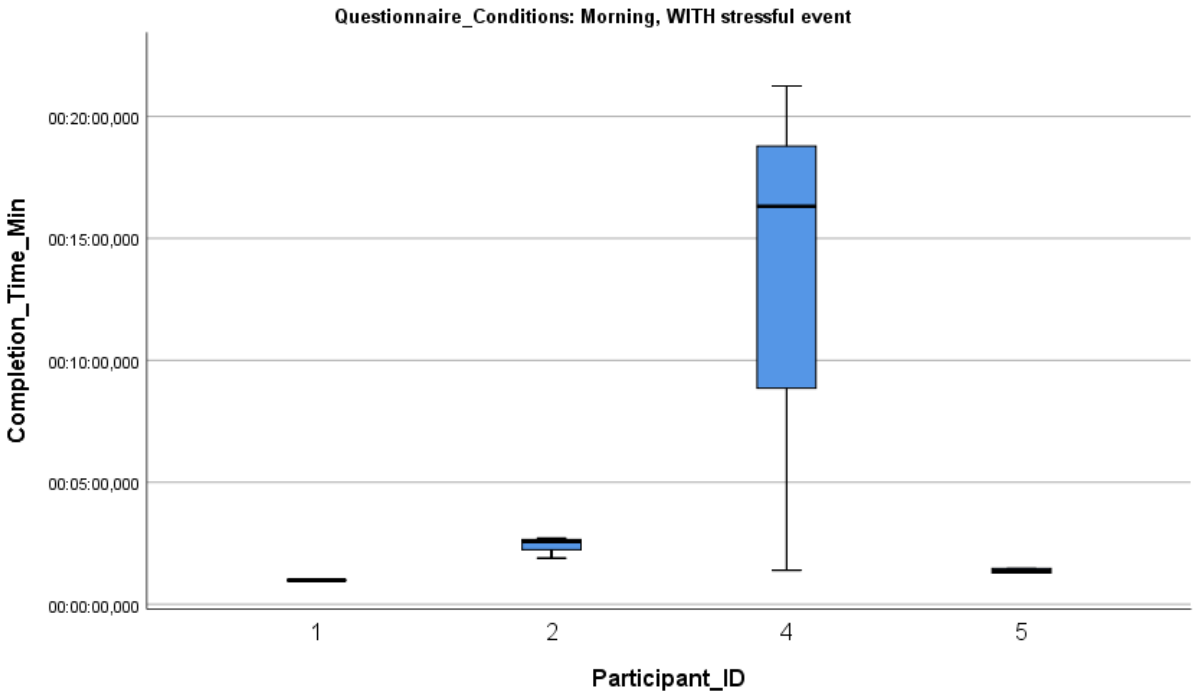

Figure 33. Boxplots - Distribution of completion time for morning questionnaires with stressful events

Daytime questionnaires – Without stressful events

Table 11 shows no descriptive results for participant 1. The lowest and highest median (IQR) was shown for participant 4 (Median = 0:00:46,38, IQR = 0:00:15,63) and participant 2 (Median = 0:01:30,08, IQR = 0:59:49,11). In participant 3, no IQR was reported because of the small difference between minimum and maximum completion time.

As seen in Figure 34, a boxplot could only be shown for participant 2. Based on this boxplot, there seems to be a slight difference between the first quartile and median. Multiple outliers were expressed in the graph. The most outstanding outlier was displayed in participant 5, with a completion time of approximate 4 hours. Due to the outliers, it is more difficult to interpret the other boxplots.

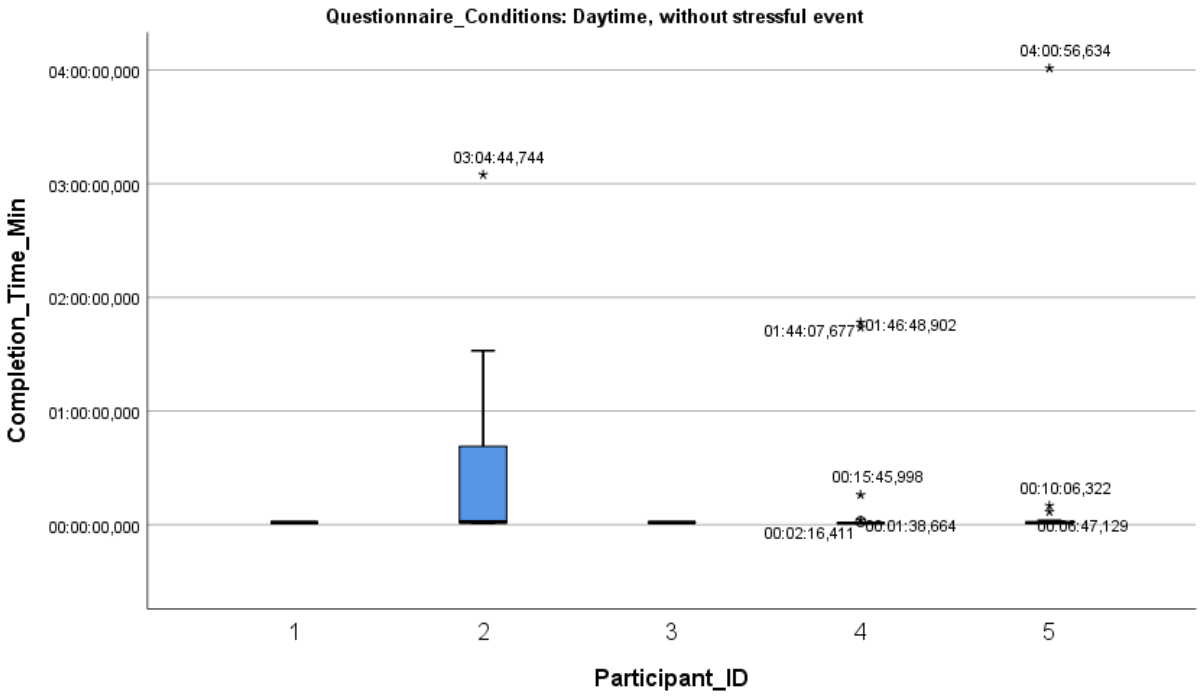

Figure 34. Boxplots – Distribution of completion time for daytime questionnaires without stressful events according to participant ID

Daytime questionnaires – With stressful events

Based on Table 11, no descriptive results could be extracted for participant 3. The lowest and highest median were presented in participant 5 (Median = 0:01:03,82, IQR = 0:00:20,90) and participant 2 (0:02:27,24, IQR = 0:01:10,01). Figure 35 illustrates boxplots for all participants, except for participant 3. Based on the graph, participant 2 showed the highest median (IQR) and widest range. One outlier was expressed for participant 4.

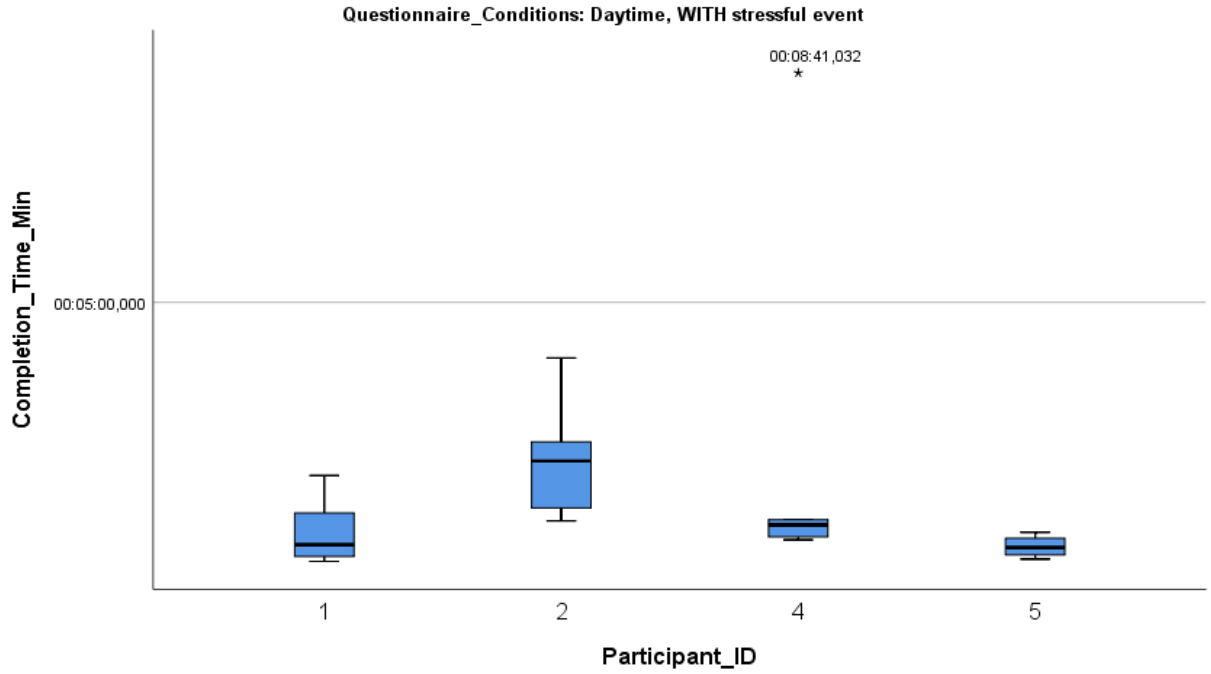

Figure 35. Boxplots – Distribution of completion time for daytime questionnaires with stressful events according to participant ID

Delay in response

Based on Table 12, there was a wide variation across participants in the median time of delay in response. Participant 3 showed the lowest median (Median = 0:00:16, no IQR) time of delay and participant 5 the highest (Median = 0:35:29,00, IQR = 0:51:42,25).

Table 12. Time delay in response (minutes) according to participant ID

Descriptive statistics

Outcome variable		***Participants***				
		1	*2*	*3*	*4*	*5*
Delay in response	**Median (IQR)**	0:02:51,00 (0:07:52,00)	0:09:06,50 (0:23:43,25)	0:00:16,00 (-)	0:02:20,00 (0:17:46,00)	0:35:29,00 (0:51:42,25)
	Minimum	0:00:12,00	0:00:11,00	0:00:04,00	0:00:04,00	0:00:08,00
	Maximum	0:36:47,00	2:21:33,00	0:00:17,00	3:33:53,00	2:35:13,00

Figure 36 illustrates the distribution of the delay in response in minutes down to milliseconds precision, according to the participant ID. The boxplots showed a wide dispersion of data, with many outliers. For example, an outlier of 03:33:53,33 was shown for participant 4, indicating that the participant swiped away the notification or did not interact with it for 3 hours and 30 minutes before starting the EMA. Due to the multiple outliers, the interpretation of the boxplots was hindered.

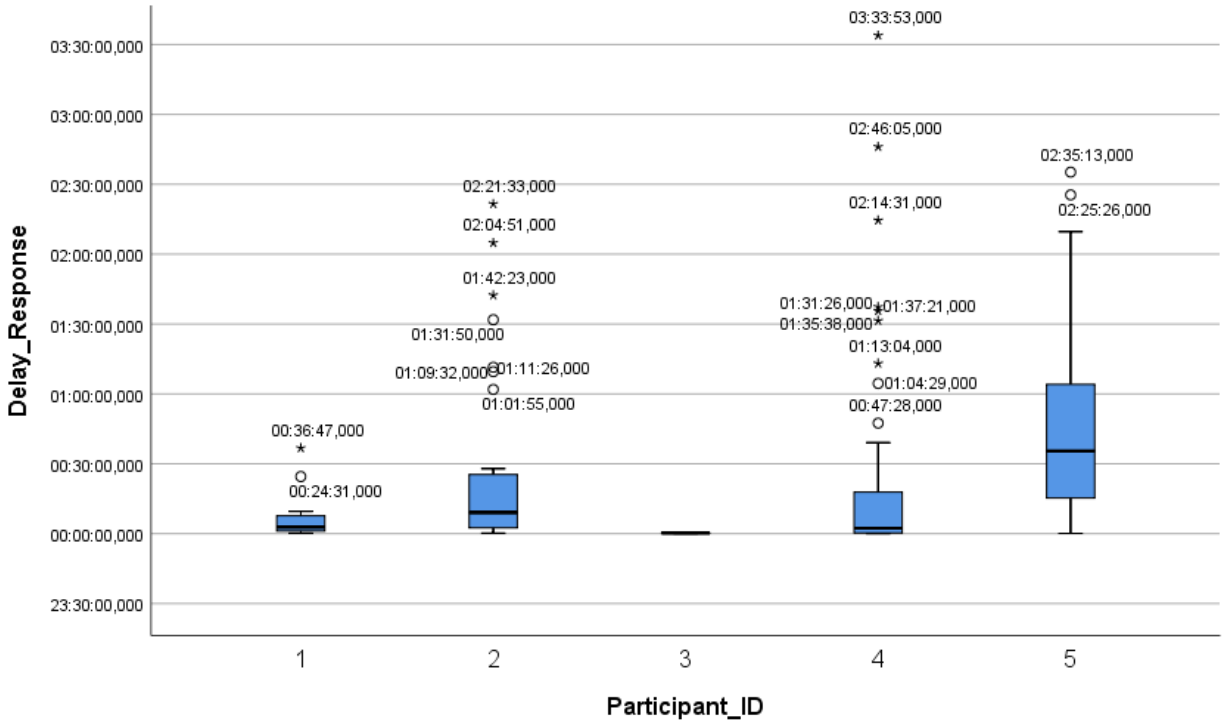

Figure 36. Distribution of delay in response according to participant ID

3.3.3 Underlying exposure and adherence

A non-parametric Spearman correlation examined the association between underlying exposure to JCQ dimensions and adherence to the EMA-protocol, with the mean number of daily completed EMAs as dependent variable and the baseline perceptions of JCQ dimensions as independent variable. The results are presented in Table 13 and 14. Furthermore, Figure 37 to 42 illustrate the scatterplots which were constructed to visualise data point patterns.

Table 13. Spearman correlations between EMAs per day and baseline perceptions of job demands, control and job strain

Spearman correlations

			Job characteristics					
			Mean EMAs per day	*Job Demands*	*Mean EMAs per day*	*Job Control*	*Mean EMAs per day*	*Demands/ control ratio*
Spearman's rho	*Mean EMAs per day*	Correlation Coefficient	1.00	0.67	1.00	-0.10	1.00	0.70
		Sig. (2-tailed)	.	0.22	.	0.87	.	0.19
		N	5	5	5	5	5	5
	Outcome variable	Correlation Coefficient	0.67	1.00	-0.10	1.00	0.70	1.00
		Sig. (2-tailed)	0.22	.	0.87	.	0.19	.
		N	5	5	5	5	5	5

Table 14. Spearman correlations between EMAs per day and baseline perceptions of social support – overall, supervisor and colleagues

Spearman correlations

			Job characteristics					
			Mean EMAs per day	*Social support - Overall*	*Mean EMAs per day*	*Social support - Supervisor*	*Mean EMAs per day*	*Social support - Colleagues*
Spearman's rho	*Mean EMAs per day*	Correlation Coefficient	1. 00	-0.90	1.00	-0.87	1.00	-0.90
		Sig. (2-tailed)	.	0.04*	.	0.054**	.	0.04*
		N	5	5	5	5	5	5
	Outcome variable	Correlation Coefficient	-0.90	1.00	-0.87	1.00	-0.90	1.00
		Sig. (2-tailed)	0.04*	.	0.054**	.	0.04*	.
		N	5	5	5	5	5	5

*Correlation is significant at P ≤ 0.05.
**Correlation is borderline significant at P ≤ 0.1.

Based on the results, baseline perceptions of overall social support (r_s = -0.900, P = 0.037) and support from colleagues (r_s = -0.900, P = 0.037) were significantly associated with the number of completed EMAs per day. Figure 41 and 43 point to a strong and negative, linear association. For both associations, one outlier was expressed in participant 1. Moreover, the results suggest a borderline significant correlation (r_s = -0.872, P = 0.054) between supervisor support and the number of completed EMAs.

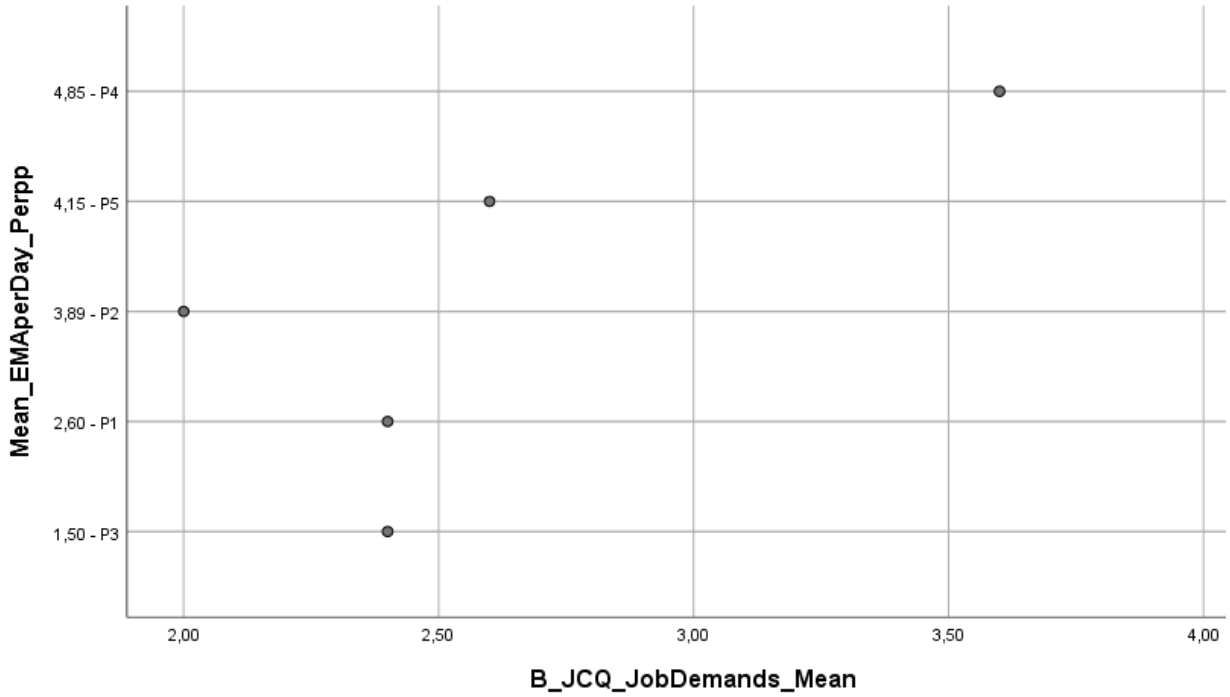

Figure 37. Correlation between the number of completed EMAs per day according to baseline perceptions of job demands

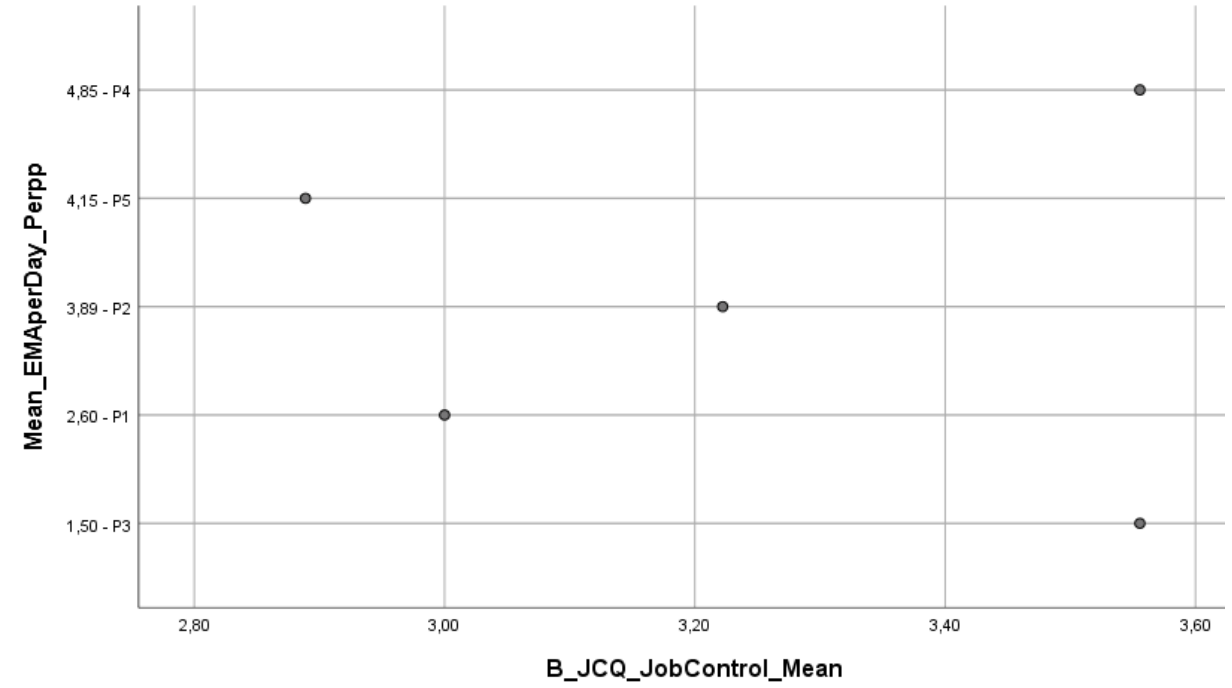

Figure 38. Correlation between the number of completed EMAs per day according to baseline perceptions of job control

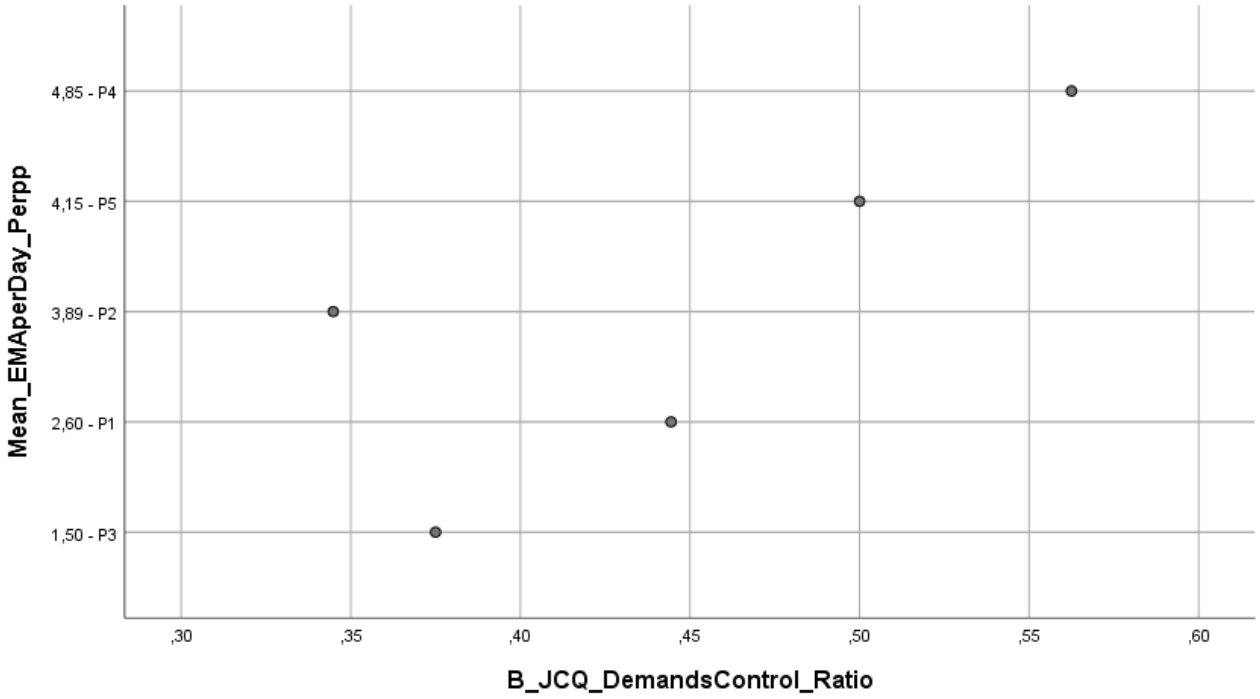

Figure 39. Correlation between the number of completed EMAs per day according to baseline perceptions of job strain

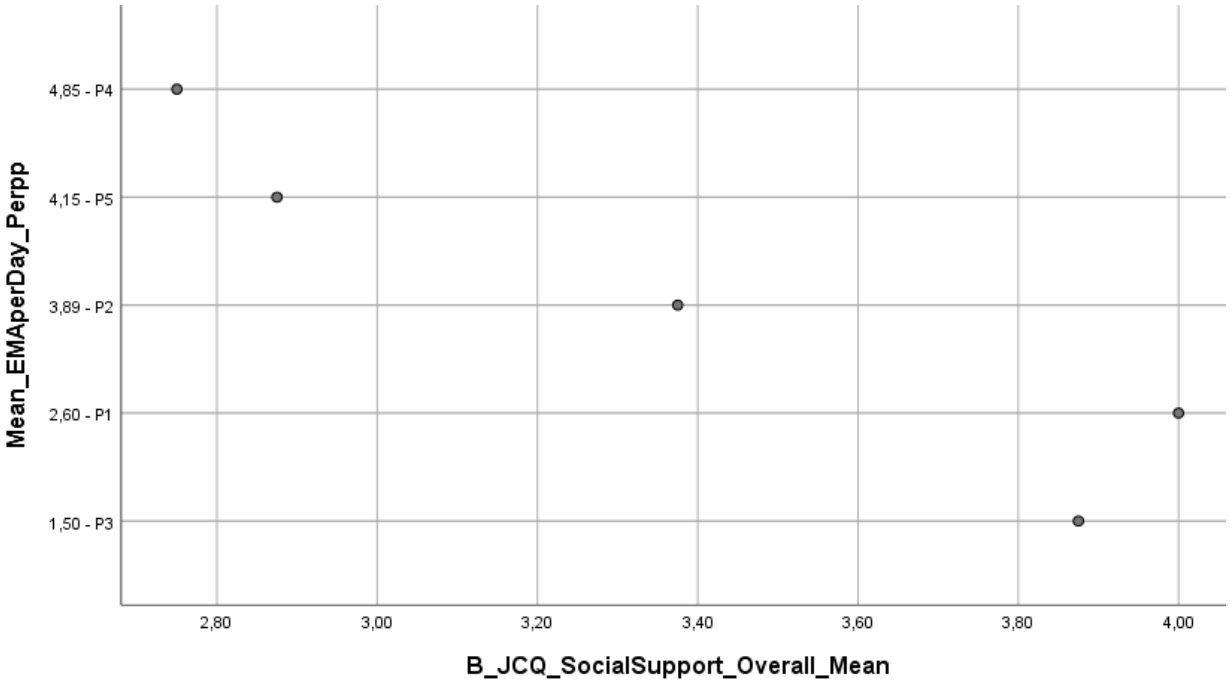

Figure 40. Correlation between the number of completed EMAs per day according to baseline perceptions of overall social support

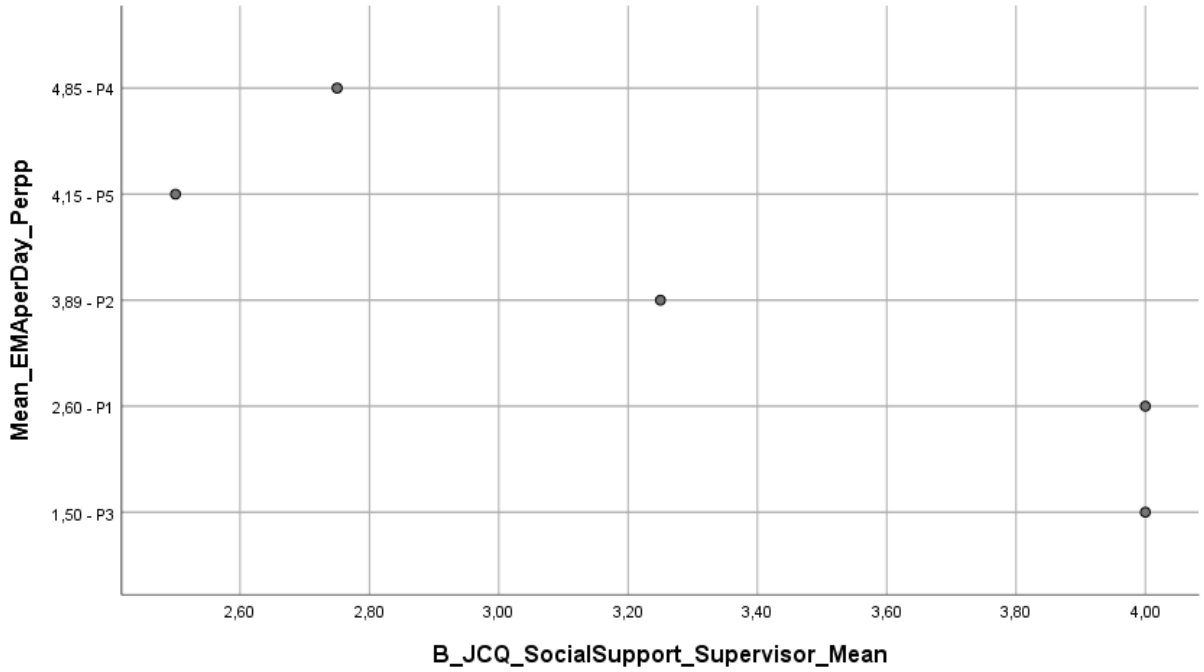

Figure 41. Correlation between the number of completed EMAs per day according to baseline perceptions of social support from supervisor

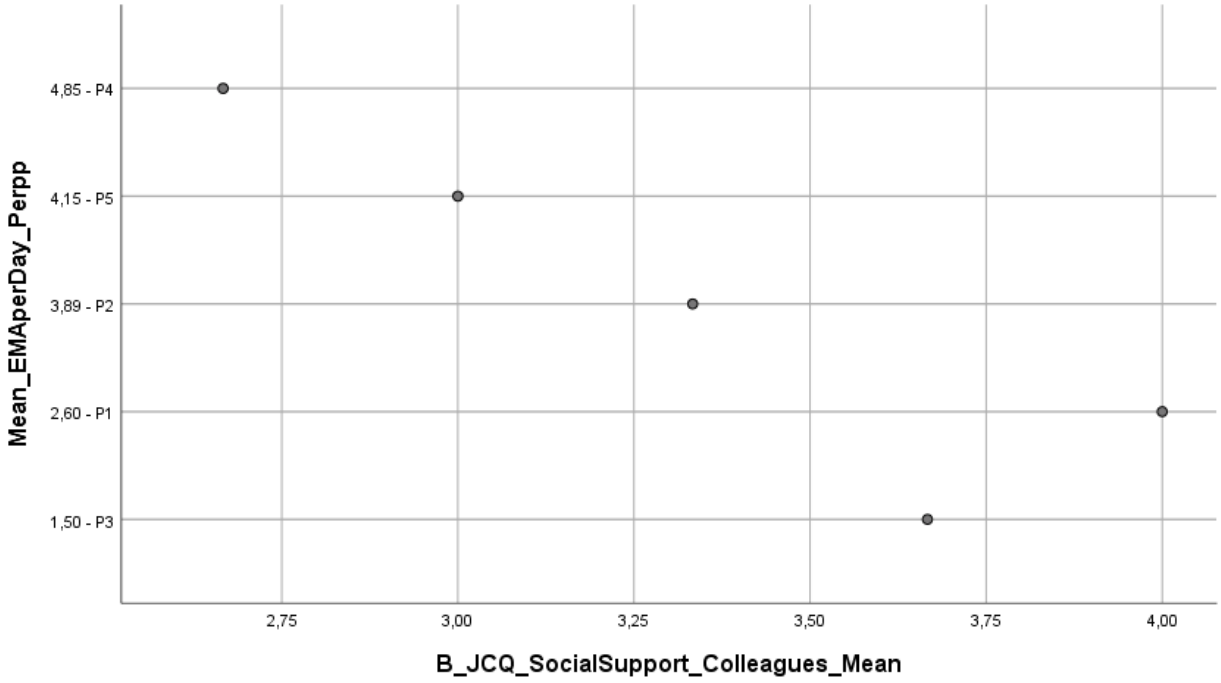

Figure 42. Correlation between the number of completed EMAs per day according to baseline perceptions of social support from colleagues

4. Discussion

This thesis was based on data from the pilot study with five participants and sought answers to the following research questions. *1. Is there a correlation between underlying exposure to psychosocial stress among personnel employed in an academic sector and the experience of day-to-day stress situations at work? 2. Is participants' adherence towards the day-to-day EMA protocol influenced by underlying exposure to psychosocial stress?* The small sample size resulted in low statistical power, therefore, all findings had to be interpreted with caution and were rather tentative.

4.1 Correlation

Firstly, the association between underlying exposure to psychosocial stress and the experience of day-to-day stress situations at work, was examined. The results suggested no obvious patterns, however, it is not certain if the low statistical power was the underlying reason.

Given the exploratory nature of this study, an obvious time effect was not expected. However, a significant association was suggested between time and day-to-day perceptions of job demands, independent of baseline perceptions. This could implicate that regardless of underlying exposure of job demands, participants' day-to-day perceptions of job demands fluctuated with time, possibly caused by the diversity in roles and tasks of academic employees. This is in line with a previous study reporting an association between experiencing job demands and academic roles of employees. Academic personnel taking on both research and teaching tasks, reported higher job demands as well as less control and social support (Kinman & Wray, 2015). The difference in experience of job demands can also result from overtime hours. In this study, two out of five participants reported more weekly working hours than described in the work agreement, from which one participant exceeded the 48 hours prescribed by the European Commission (2017). However, it is not certain whether the extra working hours caused work-related stress or were a way of coping with the high demands (Fontinha et al., 2019).

Based on the full-factorial model, no significant associations were suggested. However, the crude model pointed to a significant association between baseline and day-to-day perceptions of supervisor support. This suggests that an increase in underlying exposure to supervisor support leads to an increase in day-to-day perceptions of this support.

Due to the limited sample and subsequently, the low statistical power, no firm conclusions could be drawn. Furthermore, this research protocol is very specific and not (yet) frequently used in

this field of research, which makes it more difficult to find comparable results. Finally, stress research is mostly focused on the relationship between health outcomes and work-related stress, rather than comparing work-related stress with underlying psychosocial stress. Although no firm conclusions could be drawn, the analytical protocol of this study is outlined and can be used in the further course of the STRAW-Project.

4.2 Adherence

The second aim of this thesis was to explore the adherence of participants towards the morning and daytime questionnaires in the EMA protocol. A lack of data points is observed as the number of completed EMAs is low, probably caused by technical issues in the app for participants 1 and 3 and/or, additionally, by incomplete or deleted EMA's (by swiping away or not interacting with the notification).

There were only 167 complete EMAs out of more than 500 initiated EMAs. This does not necessarily mean that adherence was low, however, it lowered the possibility of assessment. This proportion of valid EMAs is contrary to previous studies reporting a completion rate of 80% (Dunton et al., 2016) and 60% (Yang et al., 2018). However, this is still a pilot study and the EMA protocol required high participants' engagement, so this result was expected. A similar conclusion was reached by Yang et al. (2018), reporting difficulties in police officers to adhere to the EMA protocol because of the multiple measurements over a prolonged time.

When comparing morning and daytime questionnaires, the range of completion time seemed to be lower for the morning questionnaires with stressful events, compared to the ones without. This was expected, considering a higher number of items was shown when a stressful situation was reported. In contrary, the completion time of the daytime questionnaires without stressful event had a wider range of time compared to the ones with stressful events, despite the lower number of items. This suggests a faster completion of the EMA's by the participant with the occurrence of a specific stressful event during the day. Probably, when the participants experienced a specific event, they felt the need to report this and consequently adhered better to the EMAs. A reason of the overall differences in completion time could not be detected. However, one study reported a significant influence of workload on the completion time of EMAs, with a lower number of completed EMAs among teachers experiencing high workload (McIntyre et al., 2016).

Based on outliers in completion time and delay in response, the STRAW-app appears to allow participants to interrupt the EMA for a long time and continue answering it after four hours, and

to swipe away or not interact with the EMA notification for three hours and 30 minutes. This is probably caused by technical issues in the app.

Finally, the Spearman correlation suggested no significant associations between underlying exposure to JCQ dimensions and the total number of EMAs completed per day. However, borderline significant associations were noticed for all social support scales. This could be explained by the fact that participants experiencing social support, were less involved with their smartphone and consequently did not interact with the EMAs. Moreover, higher social support could also lead to more distraction, resulting in the interruption of EMAs without finishing them.

Overall, it seems as if the interest in the EMA approach has only recently grown in research of work-related stress. For this reason, just a few studies examining the feasibility of the EMA protocol in stress research were found. The feasibility of this EMA approach has been acknowledged in teachers' highly complex environment, with job control as an important facilitator for the use of EMAs (McIntyre et al., 2016). However, it seems that no studies could be found examining this approach in an academic setting. In addition, the concept of adherence was not clearly defined because of the exploratory nature of this study, which made it difficult to determine whether the adherence was low or high and to provide a conclusive answer to the research question. Whilst no solid conclusions were taken, the analytical approach was outlined for assessing the feasibility of the EMA protocol.

4.3 Strengths and limitations

As in every research, this study has its limitations. Before describing them in general, it should be mentioned that a specific limitation was expressed due to the COVID-19 pandemic. Under normal circumstances the sample would have consisted of 15 participants, however, the recruitment had to be discontinued. This resulted in a smaller sample size of five participants and therefore a low statistical power, which means no solid conclusions could be drawn.

The study should be viewed in light of the following general limitations. Firstly, there were a lot of missing data points, mostly due to technical issues in the self-developed app. This was not unexpected since it is a newly developed app that was tested in the pilot study. Also, the EMA protocol required a lot of participation from the participants, which made it more difficult to adhere to the protocol.

Secondly, only two items of the JCQ dimensions were asked at once, to restrict the length of the EMA, leading to the limited interpretation of these scales. Besides, the subscales of social

support were only asked once a day in the evening questionnaires (separately from the other scales), resulting in a higher risk of missing data for these scales.

Furthermore, the findings of this study cannot be generalised to other groups. Firstly, participants were recruited through convenience sampling, increasing the risk of selection bias. Also, the homogeneity of the sample size restricted a good representation of the target population. Furthermore, no sociodemographic variables were included in the analyses, so moderating effects could not be examined. Another limitation concerns the self-reported measures of the perceptions of JCQ dimensions. To validate these subjective measures, it could be valuable to include objective measurements of perceived stress. Lastly, the study was limited by the exclusion of incomplete EMAs for the assessment of adherence. As a result, a large part of the data was not analysed, even though this data could also reveal valuable information about participants' adherence.

It is important to highlight the strengths as well. Firstly, the research protocol allowed to obtain cross-sectional and longitudinal data, which made it possible to compare underlying exposure to work-related stress at baseline with changes in perceptions over time. Given the small sample size, it was possible to make in-depth observations at the participant level. Furthermore, this research examined the feasibility of the EMA protocol in the academic sector as it provides valuable information for the follow-up of the STRAW-Project and even for other research settings. Also, this study described a very extensive methodological pathway and analytical protocol for highly frequent and complex data, which is interesting for further research in the STRAW-Project and is not often seen in epidemiological research.

5. Conclusion

This thesis primarily outlined the analytical protocol of this study, without taking solid conclusions on results due to the small sample size. Based on the five participants, no obvious patterns were expressed in the experiences of work-related stress. However, day-to-day perceptions of job demands seem to be associated with time. Additionally, an association was suggested between exposure to underlying supervisor support and day-to-day experience of supervisor support.

Challenges of adherence were pointed out for the five participants, such as completion time and delay in response. Furthermore, no significant associations were suggested between underlying psychosocial stress and adherence. Because of the exploratory nature of the study, the concept of adherence was not clearly defined. This made it difficult to determine whether the adherence was low or high and to provide a conclusive answer to the research question. The EMA approach is also a recent field of research and is not (yet) frequently used in this specific context.

5.1 Recommendations

Since no real intervention was carried out, recommendations were only formulated for the scientific research field. For its further course, the STRAW-Project needs a larger sample size in order to obtain robustness of statistical analyses and more consistent and reliable results. The analytical protocol described, should be further applied in the STRAW-Project. Further, sociodemographic variables such as gender, health behaviours, and academic roles should be included in the statistical analyses to examine a possible moderating effect on experiences of work-related stress. At last, it is recommended to make adaptations to the research protocol based on the findings concerning technical issues in the app. Moreover, more straightforward results on EMAs are needed to make a good assessment on the feasibility of the EMA protocol. When following these recommendations, the STRAW-Project will most likely contribute novel and very valuable results to the research field of work-related stress.

Reference list

Ahola, K., & Hakanen, J. (2007). Job strain, burnout, and depressive symptoms: A prospective study among dentists. *Journal of Affective Disorders, 104*(1), 103-110. https://doi.org/10.1016/j.jad.2007.03.004

Backe, E. M., Seidler, A., Latza, U., Rossnagel, K., & Schumann, B. (2012). The role of psychosocial stress at work for the development of cardiovascular diseases: a systematic review. *International Archives of Occupational and Environmental Health, 85*(1), 67-79. https://doi.org/10.1007/s00420-011-0643-6

Baidwan, N. K., Gerberich, S. G., Kim, H., Ryan, A., Church, T., & Capistrant, B. (2019). A longitudinal study of work-related psychosocial factors and injuries: Implications for the agin g United States workforce. *American Journal of Industrial Medicine*, *62*(3), 212-221. https://doi.org/10.1002/ajim.22945

Bertz, J. W., Epstein, D. H., & Preston, K. L. (2018). Combining ecological momentary assessment with objective, ambulatory measures of behavior and physiology in substance-use research. Addictive Behaviors, 83, 5-17. doi:https://doi.org/10.1016/j.addbeh.2017.11.027

Bloomfield, M. A., McCutcheon, R. A., Kempton, M., Freeman, T. P., & Howes, O. (2019). The effects of psychosocial stress on dopaminergic function and the acute stress response. *eLife*, *8*. https://doi.org/10.7554/eLife.46797

Bourdeaud'hui, R., Janssens, F. & Vanderhaeghe, S. (2019). *Rapport Vlaamse werkbaarheidsmonitor 2019 - werknemers.* Retrieved February 22, 2020 from the Stichting https://www.serv.be/stichting/publicatie/werkbaarheidsmonitor-2019-werknemers

Celik, S., Celik, K., Dirimese, E., Taşdemir, N., Arik, T., & Büyükkara, İ. (2018). Determination of pain in musculoskeletal system reported by office workers and the pain risk factors. *International Journal of Occupational Medicine and Environmental Health, 31*(1), 91-111. https://doi.org/10.13075/ijomeh.1896.00901

Choi, B., Bjorner, J. B., Ostergren, P. O., Clays, E., Houtman, I., Punnett, L., Rosengren, A., De Bacquer, D., Ferrario, M., Bilau, M. & Karasek, R. (2009). Cross-language differential item functioning of the job content questionnaire among European countries: the JACE study. *International journal of behavioral medicine, 16*(2), 136-147. https://doi.org/10.1007/s12529-009-9048-2

Claus, M., Schuster, M., Webendorfer, S., Groneberg, D. A., Jahner, J., & Schiffmann, D. (2019). Prevalence of back pain in employees of a German chemical company: results of a large cross-sectional study. *Journal of occupational medicine and toxicology (London, England), 14*, 16. https://doi.org/10.1186/s12995-019-0236-y

Cohen, S. (1994). *Perceived stress scale.* Retrieved March 16, 2020 from http://www.mindgarden.com/documents/PerceivedStressScale.pdf

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior, 24*(4), 385-396. https://doi.org/10.2307/2136404

De Kok, J., Vroonhof, P., Snijders, J., Roullis, G., Clarke, M., Peereboom, K., van Dorst, P. & Isusi, I. (2019). *Work-related MSDs: prevalence, costs and demographics in the EU.*

Retrieved March 31, 2020, from the European Agency for Safety and Health at Work website: https://osha.europa.eu/en/publications/summary-msds-facts-and-figures-overview-prevalence-costs-and-demographics-msds-europe

Dunton, G. F., Dzubur, E., & Intille, S. (2016). Feasibility and Performance Test of a Real-Time Sensor-Informed Context-Sensitive Ecological Momentary Assessment to Capture Physical Activity. J Med Internet Res, 18(6), e106. https://doi.org/10.2196/jmir.5398

El Shikieri, A. B., & Musa, H. A. (2012). Factors associated with occupational stress and their effects on organizational performance in a Sudanese University. *Creative Education, 3*(01), 134. https://doi.org/10.4236/ce.2012.31022

Eltayeb, S., Staal, J. B., Hassan, A., & de Bie, R. A. (2009). Work Related Risk Factors for Neck, Shoulder and Arms Complaints: A Cohort Study Among Dutch Computer Office Workers. *Journal of Occupational Rehabilitation, 19*(4), 315-322. https://doi.org/10.1007/s10926-009-9196-x

Eurofound. (2017). *Sixth European working conditions survey - Overview report (2017 update)*. Publications office of the European Union, Luxembourg. https://doi.org/10.2806/422172

European Commission. (2017). *Interpretative Communication on Directive 2003/88/EC of the European Parliament and of the Council concerning certain aspects of the organisation of working time.* Luxembourg: Publications Office of the European Union.

Federale Overheidsdienst Werkgelegenheid, Arbeid en Sociaal Overleg (FOD WASO). (2007). *BELSTRESS III ONDERZOEKSRAPPORT: Onderzoek naar determinanten van werkverzuim wegens ziekte bij mannen en vrouwen.* Retrieved February 22, 2020 from https://werk.belgie.be/sites/default/files/content/documents/Welzijn%20op%20het%20werk/Onderzoeksprojecten/d77c813e99a74673aae131c833d1ece82.pdf

Fontinha, R., Easton, S., & Van Laar, D. (2019). Overtime and quality of working life in academics and nonacademics: The role of perceived work-life balance. International Journal of Stress Management, 26(2), 173. https://doi.org/10.1037/str0000067

Franco-Santos, M., & Doherty, N. (2017). Performance management and well-being: a close look at the changing nature of the UK higher education workplace. International Journal of Human Resource Management, 28(16), 2319-2350. https://doi.org/0.1080/09585192.2017.1334148

Gjoreski, M., Luštrek, M., Gams, M., & Gjoreski, H. (2017). Monitoring stress with a wrist device using context. *Journal of biomedical informatics, 73*, 159-170. https://doi.org/10.1016/j.jbi.2017.08.006

Herr, R. M., Bosch, J. A., Loerbroks, A., van Vianen, A. E. M., Jarczok, M. N., Fischer, J. E., & Schmidt, B. (2015). Three job stress models and their relationship with musculoskeletal pain in blue- and white-collar workers. *Journal of psychosomatic research, 79*(5), 340-347. https://doi.org/10.1016/j.jpsychores.2015.08.001

Heron, K. E., & Smyth, J. M. (2010). Ecological momentary interventions: incorporating mobile technology into psychosocial and health behaviour treatments. British journal of health psychology, 15(1), 1-39. https://doi.org/10.1348/135910709X466063

Hyde, A., Clarke, M., & Drennan, J. (2013). The changing role of academics and the rise of managerialism. In *The academic profession in Europe: New tasks and new challenges* (pp. 39-52): Springer.

Janssens, H., Braeckman, L., De Clercq, B., Casini, A., Bacquer, D., Kittel, F., & Clays, E. (2016). The indirect association of job strain with long-term sickness absence through bullying: A mediation analysis using structural equation modeling. *Bmc Public Health, 16*, 851. https://doi.org/10.1186/s12889-016-3522-y

Johnson, J. V., Hall, E. M., & Theorell, T. (1989). Combined effects of job strain and social isolation on cardiovascular disease morbidity and mortality in a random sample of the Swedish male working population. *Scandinavian journal of work, environment & health, 15(4)*, 271-279. https://doi.org/10.5271/sjweh.1852

Johnson, J., & Hall, E. M. (1988). Job Strain, Work Place Social Support, and Cardiovascular Disease: A Cross-sectional Study of a Random Sample of the Swedish Working Population. *American Journal of Public Health, 78*, 1336-1342. https://doi.org/10.2105/AJPH.78.10.1336

Jun, D. H., Johnston, V., McPhail, S. M., & O'Leary, S. A Longitudinal Evaluation of Risk Factors and Interactions for the Development of Nonspecific Neck Pain in Office Workers in Two Cultures. *Human Factors*, 21. https://doi.org/10.1177/0018720820904231

Juster, R.-P., McEwen, B. S., & Lupien, S. J. (2010). Allostatic load biomarkers of chronic stress and impact on health and cognition. *Neuroscience & Biobehavioral Reviews, 35*(1), 2-16. https://doi.org/10.2478/v10001-010-0035-2

Karasek Jr, R. A. (1979). Job demands, job decision latitude, and mental strain: Implications for job redesign. *Administrative science quarterly*, 285-308. https://doi.org/10.2307/2392498

Karasek, R., Baker, D., Marxer, F., Ahlbom, A., & Theorell, T. (1981). Job decision latitude, job demands, and cardiovascular disease: a prospective study of Swedish men. *American Journal of Public Health, 71(7)*, 694-705. https://doi.org/10.2105/AJPH.71.7.694

Karasek, R., Collins, S., Clays, E., Bortkiewicz, A., & Ferrario, M. (2010). Description of a large-scale study design to assess work-stress-disease associations for cardiovascular disease. *International Journal of Occupational Medicine and Environmental Health, 23*(3), 293-312. https://doi.org/10.2478/v10001-010-0035-2

Karasek, R., Quintal, L. Brisson, C., Kawakami, N., Houtman, I., Bongers, P. & Amick, B. (1998). The Job Content Questionnaire (JCQ): An Instrument for Internationally Comparative Assessments of Psychosocial Job Characteristics. *Journal of Occupational Health Psychology*, *3*(4), 322-355. https://doi.org/10.1037/1076-8998.3.4.322

Kinman, G., & Wray, S. (2015). *Work-related wellbeing in UK Higher Education-2014*. Retrieved from https://www.researchgate.net/publication/319464567_Work-related_wellbeing_in_UK_Higher_Education-2014 https://doi.org/10.13140/RG.2.2.24867.76321

Kivimäki, M., & Kawachi, I. (2015). Work Stress as a Risk Factor for Cardiovascular Disease. *Current cardiology reports, 17*(9), 630-630. https://doi.org/10.1007/s11886-015-0630-8-8

Kivimaki, M., Nyberg, S. T., Batty, G. D., Fransson, E. I., Heikkila, K., Alfredsson, L., Bjorner, J. B., Borritz, M., Burr, H., Casini, A., Clays, E., De Bacquer, D., Dragano, N., Ferrie, J. E., Geuskens, G. A., Goldberg, M., Hamer, M., Hooftman, W. E., Houtman, I. L., . . . Theorell, T. (2012). Job strain as a risk factor for coronary heart disease: a collaborative meta-analysis of individual participant data. *Lancet, 380*(9852), 1491-1497. https://doi.org/10.1016/S0140-6736(12)60994-5

Lagraauw, H. M., Kuiper, J., & Bot, I. (2015). Acute and chronic psychological stress as risk factors for cardiovascular disease: Insights gained from epidemiological, clinical and experimental studies. *Brain, Behavior, and Immunity, 50*, 18-30. https://doi.org/10.1016/j.bbi.2015.08.007

Lang, J., Ochsmann, E., Kraus, T., & Lang, J. W. B. (2012). Psychosocial work stressors as antecedents of musculoskeletal problems: A systematic review and meta-analysis of stability-adjusted longitudinal studies. *Social Science & Medicine, 75*(7), 1163-1174. https://doi.org/10.1016/j.socscimed.2012.04.015

Lazarus, R. S., & Cohen, J. B. (1977). *Environmental Stress*. In I. Altman & J. F. Wohlwill (Eds.), Human Behavior and Environment: Advances in Theory and Research, 2, p.89-127. Boston, MA: Springer US.

Lazarus, R. S., & Folkman, S. (1984). *Stress, Appraisal, and Coping.* New York: Springer Publishing Company. Retrieved from https://books.google.be/books?hl=nl&lr=&id=i-ySQQuUpr8C&oi=fnd&pg=PR5&dq=Lazarus,+R.+S.,+%26+Folkman,+S.+(1984).+Stress,+Appraisal,+and+Coping.+New+York:+Springer+Publishing+Company.+DOI&ots=DfKRluggQe&sig=3IOGPIjW5kCWTCl4a9-TonW1iBM#v=onepage&q&f=false

Levecque, K., Anseel, F., De Beuckelaer, A., Van der Heyden, J., & Gislef, L. (2017). Work organization and mental health problems in PhD students. *Research Policy, 46*(4), 868-879. https://doi.org/10.1016/j.respol.2017.02.008

Le Fevre, M., Matheny, J., & Kolt, G. S. (2003). Eustress, distress, and interpretation in occupational stress. *Journal of Managerial Psychology, 18*(7), 726-744. https://doi.org/10.1108/02683940310502412

Lumley, M. A., Shi, W. S., Wiholm, C., Slatcher, R. B., Sandmark, H., Wang, S. N., Hytter, A. & Arnetz, B. B. (2014). The Relationship of Chronic and Momentary Work Stress to Cardiac Reactivity in Female Managers: Feasibility of a Smart Phone-Assisted Assessment System. *Psychosomatic medicine, 76*(7), 512-518. https://doi.org/10.1097/psy.0000000000000085

Mark, G., & Smith, A. P. (2012). Effects of occupational stress, job characteristics, coping, and attributional style on the mental health and job satisfaction of university employees. Anxiety, Stress & Coping, 25(1), 63-78. https://doi.org/10.1080/10615806.2010.548088

Martikainen, P., Bartley, M., & Lahelma, E. (2002). Psychosocial determinants of health in social epidemiology. *International Journal of Epidemiology, 31,* 1091-1093. https://doi.org/10.1093/ije/31.6.1091

Maslach, C., & Leiter, M. P. (2016). Understanding the burnout experience: recent research and its implications for psychiatry. World psychiatry : official journal of the World Psychiatric Association (WPA), 15(2), 103-111. https://doi.org/10.1002/wps.20311

Mather, L., Ropponen, A., Mittendorfer-Rutz, E., Narusyte, J., & Svedberg, P. (2019). Health, work and demographic factors associated with a lower risk of work disability and unemployment in employees with lower back, neck and shoulder pain. *Bmc Musculoskeletal Disorders, 20*(1), 10. https://doi.org/10.1186/s12891-019-2999-9

McCarthy, C., Pradhan, N., Redpath, C., & Adler, A. (2016). *Validation of the Empatica E4 wristband.* Retrieved from IEEE Explore website: https://ieeexplore.ieee.org/abstract/document/7508621

McDonald, M., DiBonaventura, M., & Ullman, S. (2011). Musculoskeletal pain in the workforce: the effects of back, arthritis, and fibromyalgia pain on quality of life and work productivity. *Journal of occupational and environmental medicine, 53*(7), 765-770. http://dx.doi.org/10.1097/JOM.0b013e318222af81

McEwen, B. S. (1998). Stress, adaptation, and disease: Allostasis and allostatic load. *Annals of the New York Academy of Sciences, 840(1)*, 33-44. https://doi.org/10.1111/j.1749-6632.1998.tb09546.x

McEwen, B. S., & Stellar, E. (1993). Stress and the individual. Mechanisms leading to disease. *Archives of Internal Medicine, 153*(18), 2093-2101. https://doi.org/10.1001/archinte.1993.00410180039004

McIntyre, T., McIntyre, S., Barr, C., Woodward, P., Francis, D., Durand, A., Mehta, P. & Kamarck, T. (2016). Longitudinal Study of the Feasibility of Using Ecological Momentary Assessment to Study Teacher Stress: Objective and Self-Reported Measures. *Journal of occupational health psychology, 21*, 403-414. https://doi.org/10.1037/a0039966

Morrish, L., & Sauntson, H. (2016). Performance Management and the Stifling of Academic Freedom and Knowledge Production. Journal of Historical Sociology, 29(1), 42-64. https://doi.org/10.1111/johs.12122

Peacock, E. J., Wong, P. T. P. (1990). The Stress Appraisal Measure (SAM): A Multidimensional Approach to Cognitive Appraisal. *Stress Medicine, 6*, 227-236. https://doi.org/10.1002/smi.2460060308

Pelfrene, E., Vlerick, P., Mak, R. P., De Smet, P., Kornitzer, M., & De Backer, G. (2001). Scale reliability and validity of the Karasek 'Job Demand-Control-Support' model in the Belstress study. *Work & Stress, 15*(4), 297-313.

Pereira, M. J., Johnston, V., Straker, L. M., Sjøgaard, G., Melloh, M., O'Leary, S. P., & Comans, T. A. (2017). An Investigation of Self-reported Health-related Productivity Loss in Office Workers and Associations With Individual and Work-related Factors Using an Employer's Perspective. *Journal of occupational and environmental medicine, 59*(7), e138-e144. https://doi.org/10.1097/jom.0000000000001043

Poulsen, P. H., Biering, K., Winding, T. N., Nohr, E. A., Petersen, L. V., Ulijaszek, S. J., & Andersen, J. H. (2019). How does psychosocial stress affect the relationship between socioeconomic disadvantage and overweight and obesity? Examining Hemmingsson's model with data from a Danish longitudinal study. *Bmc Public Health, 19*(1), 1475. https://doi.org/10.1186/s12889-019-7699-8

Rose, D. M., Seidler, A., Nubling, M., Latza, U., Brahler, E., Klein, E. M., Wiltink, J., Michal, M., Nickels, S., Wild, P. S., Konig, J., Claus, M., Letzel, S. & Beutel, M. E. (2017). Associations

of fatigue to work-related stress, mental and physical health in an employed community sample. *BMC psychiatry, 17*(1), 167. https://doi.org/10.1186/s12888-017-1237-y

Schneiderman, N., Ironson, G., & Siegel, S. D. (2005). Stress and health: psychological, behavioral, and biological determinants. *Annual review of clinical psychology*, *1*, 607-628. https://doi.org/10.1146/annurev.clinpsy.1.102803.144141

Selye, H. (1976). Stress without distress. In G. Serban, *Psychopathology of Human Adaptation* (pp. 137-146). New York: Plenum Publishing Corporation. https://**doi**.org/10.1007/978-1-4684-2238-2_9

Sembajwe, G., Wahrendorf, M., Siegrist, J., Sitta, R., Zins, M., Goldberg, M., & Berkman, L. (2012). Effects of job strain on fatigue: cross-sectional and prospective views of the job content questionnaire and effort–reward imbalance in the GAZEL cohort. *Occupational and Environmental Medicine, 69*(6), 377. http://dx.doi.org/10.1136/oem.2010.063503

Shiffman, S., Stone, A. A. & Hufford, M. R. (2008). Ecological Momentary Assessment. *The Annual Review of Clinical Psychology*, *4*, 1–32. https://doi.org/10.1146/annurev.clinpsy.3.022806.091415

Siegrist, J. (1996). Adverse health effects of high-effort/low-reward conditions. *Journal of occupational health psychology, 1*(1), 27-41. https://doi.org/10.1037/1076-8998.1.1.27

Siegrist, J. (2009). Unfair exchange and health: Social bases of stress-related diseases. *Social Theory & Health*, *7*(4), 305-317. https://doi.org/10.1057/sth.2009.17

Siegrist, J. (2012). *Effort-reward imbalance at work - theory, measurement and evidence.* Retrieved from https://www.uniklinik-duesseldorf.de/fileadmin/Fuer-Patienten-und-Besucher/Kliniken-Zentren-Institute/Institute/Institut_fuer_Medizinische_Soziologie/Dateien/ERI/ERI-Website.pdf

Siegrist, J., Peter, R., Junge, A., Cremer, P., & Seidel, D. (1990). Low status control, high effort at work and ischemic heart disease: Prospective evidence from blue-collar men. *Social Science & Medicine, 31(10)*, 1127-1134. https://doi.org/10.1016/0277-9536(90)90234-J

Siegrist, J., Starke, D., Chandola, T., Godin, I., Marmot, M., Niedhammer, I., & Peter, R. (2004). The measurement of effort–reward imbalance at work: European comparisons. *Social Science & Medicine, 58*(8), 1483-1499. https://doi.org/https://doi.org/10.1016/S0277-9536(03)00351-4

Spruill, T. M. (2010). Chronic psychosocial stress and hypertension. *Current hypertension reports, 12*(1), 10-16. https://doi.org/10.1007/s11906-009-0084-8

Stansfeld, S. A., Shipley, M. J., Head, J., & Fuhrer, R. (2012). Repeated Job Strain and the Risk of Depression: Longitudinal Analyses From the Whitehall II Study. *American Journal of Public Health, 102*(12), 2360-2366. https://doi.org/10.2105/AJPH.2011.300589

Stauder, A., Cserhati, Z., & Thege, B. K. (2018). Decreasing the negative effects of work-related stress in unchanged working environments. *European Journal of Mental Health*, 13(2), 163-183. https://doi.org/10.5708/ejmh.13.2018.2.

Steptoe, A., Hiltl, T. J., Dowd, J. B., & Hamer, M. (2019). Socioeconomic status and central adiposity as determinants of stress-related biological responses relevant to cardiovascular

disease risk. *Brain Behavior and Immunity, 77*, 16-24. https://doi.org/10.1016/j.bbi.2018.11.019

Sterling, P., & Eyer, J. (1981). Biological basis of stress-related mortality. *Social Science & Medicine. Part E: Medical Psychology, 15*(1), 3-42. https://doi.org/10.1016/0271-5384(81)90061-2

Theorell, T., Jood, K., Järvholm, L. S., Vingård, E., Perk, J., Östergren, P. O., & Hall, C. (2016). A systematic review of studies in the contributions of the work environment to ischaemic heart disease development. *European Journal of Public Health, 26*(3), 470-477. https://doi.org/10.1093/eurpub/ckw025

Thorsteinsson, E. B., Brown, R. F., & Richards, C. (2014). The relationship between work-stress, psychological stress and staff health and work outcomes in office workers. *Psychology 5*(10), 1301–1311. https://doi.org/10.4236/psych.2014.510141

Van der Doef, M., & Maes, S. (1999). The Job Demand-Control (-Support) Model and psychological well-being: A review of 20 years of empirical research. *Work & Stress, 13*(2), 87-114. https://doi.org/10.1080/026783799296084

Van Gyes, G. (2006). *The Flemish workability monitor: a broad focus on quality of work.* Retrieved March 6, 2020 from the Eurofound website: https://www.eurofound.europa.eu/sites/default/files/ef_files/ewco/surveyreports/BE060601SD/BE060601SD.pdf

Vlaams Economisch Sociaal Overlegcomité. (2009). *Pact 2020: Een nieuw toekomstpact voor Vlaanderen 20 doelstellingen.* Retrieved February 22, 2020 from https://www.serv.be/serv/publicatie/pact-2020-nieuw-toekomstpact-vlaanderen-20-doelstellingen

Wentz, K., Gyllensten, K., Sluiter, J. K., & Hagberg, M. (2020). Need for recovery in relation to effort from work and health in four occupations. *International Archives of Occupational and Environmental Health, 93*(2), 243-259. https://doi.org/10.1007/s00420-019-01476-7

World Health Organization (WHO). (2020). *Constitution*. Retrieved from https://www.who.int/about/who-we-are/constitution

World Health Organization (WHO). (n.d.). *Occupational health*. Retrieved from https://www.who.int/occupational_health/topics/stressatwp/en/

Yang, Y. S., Ryu, G. W., Han, I., Oh, S., & Choi, M. (2018). Ecological Momentary Assessment Using Smartphone-Based Mobile Application for Affect and Stress Assessment. Healthc Inform Res, 24(4), 381-386. https://doi.org/10.4258/hir.2018.24.4.381

Appendices

Appendix A: Permission Committee for Medical Ethics – STRAW-Project: Disentangling the sources and context of day-to-day STRess At Work.

Afz.: Commissie voor Medische Ethiek

Maatschappelijke Gezondheidszorg
Prof. dr. Els CLAYS

Alhier

contact	telefoon	e-mail
Ann Haenebalcke Commissie voor medische Ethiek	+32 (0)9 332 22 66	Ethisch.comite@uzgent.be ann.haenebalcke@uzgent.be

Ons kenmerk	Uw kenmerk	datum	pagina
2019/1091		9-sep-19	1/2

Betreft :

Advies voor monocentrische studie met als titel:
STRAW Project - Disentangling the sources and context of daily STRess At Work.

Belgisch Registratienummer: B670201940987

Fase (Phase): NVT/NA

* Begeleidende brief dd. 10/07/2019
* Brief
  - Informatiebrief deelnemer dd 10/07/2019
* Patiëntenmateriaal
  - Rekruteringsemail
* Vragenlijsten
  - Baseline Screening
  - EMA Survey
* Diverse
  - Detection of context using AWARE dd 05/07/2019
  - Task overview
  - Bewijs financiering FWO
* Antwoord onderzoekers
  dd 02/09/2019 op opmerkingen EC dd 14/08/2019
* Adviesaanvraagformulier
  (Ontvangen dd 02/09/2019) Versie 2
* (patiënten)- informatie en toestemmingsformulier dd. 02/09/2019
  (Versie 2)

Advies werd gevraagd door:
Prof. dr. E. CLAYS ; Hoofdonderzoeker

BOVENVERMELDE DOCUMENTEN WERDEN DOOR HET ETHISCH COMITÉ BEOORDEELD. ER WERD EEN POSITIEF ADVIES GEGEVEN OVER DIT PROTOCOL OP 06/09/2019. INDIEN DE STUDIE NIET WORDT OPGESTART VOOR 05/09/2020, VERVALT HET ADVIES EN MOET HET PROJECT TERUG INGEDIEND WORDEN.
Vooraleer het onderzoek te starten dient contact te worden genomen met Bimetra Clinics (09/332 05 00).

THE ABOVE MENTIONED DOCUMENTS HAVE BEEN REVIEWED BY THE ETHICS COMMITTEE.A POSITIVE ADVICE WAS GIVEN FOR THIS PROTOCOL ON 06/09/2019. IN CASE THIS STUDY IS NOT STARTED BY 05/09/2020, THIS ADVICE WILL BE NO LONGER VALID AND THE PROJECT MUST BE RESUBMITTED.
Before initieting the study, please contact Bimetra Clinics (09/332 05 00).

DIT ADVIES WORDT OPGENOMEN IN HET VERSLAG VAN DE VERGADERING VAN HET ETHISCH COMITE VAN 17/09/2019
THIS ADVICE WILL APPEAR IN THE PROCEEDINGS OF THE MEETING OF THE ETHICS COMMITTEE OF 17/09/2019

ALGEMENE DIRECTIE
Commissie voor Medische Ethiek

VOORZITTER
Prof.dr. D. Mallhys

SECRETARIS
Prof.dr. J. Decruyenaere

STAFMEDEWERKER
Muriel Fouquet
T +32(09) 332 33 36
Sara De Smet
T +32(09) 332 68 55
Sabine Van de Moortele
T +32(09) 332 68 54

SECRETARIAAT
Wendy Van de Velde
T +32(09) 332 66 13
Sandra De Paepe
T +32(09) 332 26 68
Ann Haenebalcke
T +32(09) 332 22 66

INGANG 75
ROUTE 7522

UZ GENT
UNIVERSITEIT GENT
Universitair Ziekenhuis Gent
C. Heymanslaan 10 | B 9000 Gent
www.uzgent.be

* *Het Ethisch Comité werkt volgens 'ICH Good Clinical Practice' - regels*
* *Het Ethisch Comité beklemtoont dat een gunstig advies niet betekent dat het Comité de verantwoordelijkheid voor het onderzoek op zich neemt. Bovendien dient U er over te waken dat Uw mening als betrokken onderzoeker wordt weergegeven in publicaties, rapporten voor de overheid enz., die het resultaat zijn van dit onderzoek.*
* *In het kader van 'Good Clinical Practice' moet de mogelijkheid bestaan dat het farmaceutisch bedrijf en de autoriteiten inzage krijgen van de originele data. In dit verband dienen de onderzoekers erover te waken dat dit gebeurt zonder schending van de privacy van de proefpersonen.*
* *Het Ethisch Comité benadrukt dat het de promotor is die garant dient te staan voor de conformiteit van de anderstalige informatie- en toestemmingsformulieren met de nederlandstalige documenten.*
* *Geen enkele onderzoeker betrokken bij deze studie is lid van het Ethisch Comité.*
* *Alle leden van het Ethisch Comité hebben dit project beoordeeld. (De ledenlijst is bijgevoegd)*
* *The Ethics Committee is organized and operates according to the 'ICH Good Clinical Practice' rules.*
* *The Ethics Committee stresses that approval of a study does not mean that the Committee accepts responsibility for it. Moreover, please keep in mind that your opinion as investigator is presented in the publications, reports to the government, etc., that are a result of this research.*
* *In the framework of 'Good Clinical Practice', the pharmaceutical company and the authorities have the right to inspect the original data. The investigators have to assure that the privacy of the subjects is respected.*
* *The Ethics Committee stresses that it is the responsibility of the promotor to guarantee the conformity of the non-dutch informed consent forms with the dutch documents.*
* *None of the investigators involved in this study is a member of the Ethics Committee.*
* *All members of the Ethics Committee have reviewed this project. (The list of the members is enclosed)*

Namens het Ethisch Comité / On behalf of the Ethics Committee

Prof. dr. D. MATTHYS
Voorzitter / Chairman

CC: De heer T. VERSCHOORE - UZ Gent - Bimetra Clinics
FAGG - Research & Development; Victor Hortaplein 40, postbus 40 1060 Brussel

Appendix B: Permission Committee for Medical Ethics – Thesis: How does overall psychosocial stress influence day-to-day stress situations at work?

Afz.: Commissie voor Medische Ethiek

Maatschappelijke Gezondheidszorg
Prof. dr. Els CLAYS

Alhier

contact	telefoon	e-mail
Ann Haenebalcke Commissie voor medische Ethiek	+32 (0)9 332 22 66	Ethisch.comite@uzgent.be ann.haenebalcke@uzgent.be

Ons kenmerk	Uw kenmerk	datum	pagina
2019/1092		9-sep-19	1/2

Betreft :

Advies voor monocentrische studie met als titel:
STRAW Project: How does overall psychosocial stress influence day-to-day stress situations at work? - Scriptie: Amber Shen

Belgisch Registratienummer: B670201940988

* Diverse, (Alle goedgekeurde documenten cfr. Project 2019/1091)
* Begeleidende brief dd. 10/07/2019
* Informatie- en waarschuwingsnota over de verwerking van informatie voor medisch-wetenschappelijk onderzoek dd. 24/07/2019 : Amber Shen
* Antwoord onderzoekers dd 02/09/2019 op opmerkingen EC dd 14/08/2019
* Adviesaanvraagformulier : (Document E) (Ontvangen dd 29/07/2019) Versie 2

Advies werd gevraagd door:
Prof. dr. E. CLAYS ; Hoofdonderzoeker

BOVENVERMELDE DOCUMENTEN WERDEN DOOR HET ETHISCH COMITÉ BEOORDEELD. ER WERD EEN POSITIEF ADVIES GEGEVEN OVER DIT PROTOCOL OP 06/09/2019. INDIEN DE STUDIE NIET WORDT OPGESTART VOOR 05/09/2020, VERVALT HET ADVIES EN MOET HET PROJECT TERUG INGEDIEND WORDEN.
Vooraleer het onderzoek te starten dient contact te worden genomen met Bimetra Clinics (09/332 05 00).

THE ABOVE MENTIONED DOCUMENTS HAVE BEEN REVIEWED BY THE ETHICS COMMITTEE.A POSITIVE ADVICE WAS GIVEN FOR THIS PROTOCOL ON 06/09/2019. IN CASE THIS STUDY IS NOT STARTED BY 05/09/2020, THIS ADVICE WILL BE NO LONGER VALID AND THE PROJECT MUST BE RESUBMITTED.
Before initiating the study, please contact Bimetra Clinics (09/332 05 00).

DIT ADVIES WORDT OPGENOMEN IN HET VERSLAG VAN DE VERGADERING VAN HET ETHISCH COMITE VAN 17/09/2019
THIS ADVICE WILL APPEAR IN THE PROCEEDINGS OF THE MEETING OF THE ETHICS COMMITTEE OF 17/09/2019

** Het Ethisch Comité werkt volgens 'ICH Good Clinical Practice' - regels*
** Het Ethisch Comité beklemtoont dat een gunstig advies niet betekent dat het Comité de verantwoordelijkheid voor het onderzoek op zich neemt. Bovendien dient U er over te waken dat Uw mening als betrokken onderzoeker wordt weergegeven in publicaties, rapporten voor de overheid enz., die het resultaat zijn van dit onderzoek.*
** In het kader van 'Good Clinical Practice' moet de mogelijkheid bestaan dat het farmaceutisch bedrijf en de autoriteiten inzage krijgen van de originele data. In dit verband dienen de onderzoekers erover te waken dat dit gebeurt zonder schending van de privacy van de proefpersonen.*
** Het Ethisch Comité benadrukt dat het de promotor is die garant dient te staan voor de conformiteit van de anderstalige informatie- en toestemmingsformulieren met de nederlandstalige documenten.*
** Geen enkele onderzoeker betrokken bij deze studie is lid van het Ethisch Comité.*

ALGEMENE DIRECTIE
Commissie voor Medische Ethiek

VOORZITTER:
Prof.dr. D. Matthys

SECRETARIS
Prof.dr. J. Decruyenaere

STAFMEDEWERKER
Muriel Fouquet
T +32(09) 332 33 96
Sara De Smet
T +32(09) 332 68 55
Sabine Van de Moortele
T +32(09) 332 68 54

SECRETARIAAT
Wendy Van de Velde
T +32(09) 332 56 13
Sandra De Peepe
T +32(09) 332 26 66
Ann Haenebalcke
T +32(09) 332 22 66

INGANG 75
ROUTE 7022

UZ GENT
UNIVERSITEIT GENT
Universitair Ziekenhuis Gent
C. Heymanslaan 10 | B 9000 Gent
www.uzgent.be

* *Alle leden van het Ethisch Comité hebben dit project beoordeeld. (De ledenlijst is bijgevoegd)*
* *The Ethics Committee is organized and operates according to the 'ICH Good Clinical Practice' rules.*
* *The Ethics Committee stresses that approval of a study does not mean that the Committee accepts responsibility for it. Moreover, please keep in mind that your opinion as investigator is presented in the publications, reports to the government, etc., that are a result of this research.*
* *In the framework of 'Good Clinical Practice', the pharmaceutical company and the authorities have the right to inspect the original data. The investigators have to assure that the privacy of the subjects is respected.*
* *The Ethics Committee stresses that it is the responsibility of the promotor to guarantee the conformity of the non-dutch informed consent forms with the dutch documents.*
* *None of the investigators involved in this study is a member of the Ethics Committee.*
* *All members of the Ethics Committee have reviewed this project. (The list of the members is enclosed)*

Namens het Ethisch Comité / On behalf of the Ethics Committee

Prof. Dr. D. MATTHYS
Voorzitter / Chairman

CC: De heer T. VERSCHOORE - UZ Gent - Bimetra Clinics
FAGG - Research & Development; Victor Hortaplein 40, postbus 40 1060 Brussel

UZ GENT
UNIVERSITEIT GENT
Universitair Ziekenhuis Gent
C. Heymanslaan 10 | B 9000 Gent
www.uzgent.be

Appendix C: Informed Consent

*Toestemmingsformulier voor de deelnemers

	Akkoord
Ik heb het document "Informatiebrief voor de deelnemers" punt 1 tot en met 6 gelezen en begrepen en ik heb er een kopij van gekregen. Ik heb uitleg gekregen over de aard, het doel en de duur van de studie en over wat men van mij verwacht.	○
Ik stem ermee in om deel te nemen aan deze studie.	○
Ik begrijp dat deelname aan de studie vrijwillig is en dat ik mij op elk ogenblik uit de studie mag terugtrekken zonder een reden voor deze beslissing op te geven.	○
Ik ben me ervan bewust dat deze studie werd goedgekeurd door een onafhankelijke Commissie voor Medische Ethiek verbonden aan het UZ Gent en de Universiteit Gent en dat deze studie zal uitgevoerd worden volgens de richtlijnen voor de goede klinische praktijk (ICH/GCP) en de verklaring van Helsinki, opgesteld ter bescherming van mensen deelnemend aan experimenten. Deze goedkeuring was in geen geval de aanzet om te beslissen om deel te nemen aan deze studie.	○
Men heeft mij ingelicht dat zowel persoonlijke gegevens als gegevens aangaande mijn gezondheid worden verwerkt en bewaard gedurende minstens 20 jaar. Ik stem hiermee in en ben op de hoogte dat ik recht heb op toegang en op verbetering van deze gegevens. Aangezien deze gegevens verwerkt worden in het kader van medisch-wetenschappelijke doeleinden, begrijp ik dat de toegang tot mijn gegevens kan uitgesteld worden tot na beëindiging van het onderzoek. Indien ik toegang wil tot mijn gegevens, zal ik mij richten tot de onderzoeker die verantwoordelijk is voor de verwerking ervan.	○

Appendix D: List of Scales and Questionnaires

Baseline screening survey

Scales and questionnaires	**References**
General information, work-related information, health and wellbeing.	Self-developed
Pittsburgh Sleep Quality Index	Buysse, D.J., Reynolds III, C.F., Monk, T.H., Berman, S.R., & Kupfer, D.J. (1989). The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. *Journal of Psychiatric Research, 28*(2), 193-213. https://doi.org/10.1016/0165-1781(89)90047-4
Job Content Questionnaire	Karasek, R., Quintal, L. Brisson, C., Kawakami, N., Houtman, I., Bongers, P. & Amick, B. (1998). The Job Content Questionnaire (JCQ): An Instrument for Internationally Comparative Assessments of Psychosocial Job Characteristics. *Journal of Occupational Health Psychology*, *3*(4), 322-355. https://doi.org/10.1037/1076-8998.3.4.322
Effort Reward Imbalance Questionnaire	Siegrist, J., Starke, D., Chandola, T., Godin, I., Marmot, M., Niedhammer, I., & Peter, R. (2004). The measurement of effort–reward imbalance at work: European comparisons. *Social Science & Medicine, 58*(8), 1483-1499. https://doi.org/10.1016/S0277-9536(03)00351-4
Perceived Stress Scale	Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior, 24*(4), 385-396. https://doi.org/ 10.2307/2136404
Short Form-12	Ware, J., Jr., Kosinski, M., & Keller, S. D. (1996). A 12-Item short-form health survey: Construction of scales and preliminary tests of reliability and validity. *Medical Care, 34*(3), 220–233. https://doi.org/ 10.2307/3766749
Connor-Davidson Resilience Scale	Connor, K. M., & Davidson, J. R. (2003). Development of a new resilience scale: The Connor-Davidson resilience scale (CD-RISC). *Depression and anxiety, 18*(2), 76-82. https://doi.org/10.1002/da.10113

COPE Inventory	Carver, C. S., Scheier, M. F., & Weintraub, J. K. (1989). Assessing coping strategies: a theoretically based approach. *Journal of personality and social psychology, 56*(2), 267-283. https://doi.org/10.1037/0022-3514.56.2.267
Recovery Experience Questionnaire	Sonnentag, S. & Fritz, C. (2007). The Recovery Experience Questionnaire: Development and Validation of a Measure for Assessing Recuperation and Unwinding From Work. *Journal of Occupational Health Psychology, 12*(3), 204-221. 10.1037/1076-8998.12.3.204
Utrecht Work Engagement Scale	Schaufeli, W. B., Bakker, A. B., & Salanova, M. (2006). The measurement of work engagement with a short questionnaire: A cross-national study. *Educational and psychological measurement, 66*(4), 701-716. https://doi.org/10.1177/0013164405282471
Perceptions of Fair Interpersonal Treatment Scale	Donovan, M. A., Drasgow, F. & Munson, L.J. (1998). The Perceptions of Fair Interpersonal Treatment scale: Development and validation of a measure of interpersonal treatment in the workplace. *Journal of Applied Psychology, 83*(5), 683-692. https://doi.org/10.1037/0021-9010.83.5.683
Work Life Balance Inventory	Hayman, J. (2005). Psychometric assessment of an instrument designed to measure work life balance. *Research and practice in human resource management, 13*(1), 85-91.

EMA survey

Scales and questionnaires	**Reference**
Pittsburgh Sleep Quality Index	Buysse, D.J., Reynolds III, C.F., Monk, T.H., Berman, S.R., & Kupfer, D.J. (1989). The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. *Journal of Psychiatric Research, 28*(2), 193-213. https://doi.org/10.1016/0165-1781(89)90047-4
Job Content Questionnaire	Karasek, R., Quintal, L. Brisson, C., Kawakami, N., Houtman, I., Bongers, P. & Amick, B. (1998). The Job Content Questionnaire (JCQ): An Instrument for Internationally Comparative Assessments of Psychosocial Job Characteristics. *Journal of Occupational Health Psychology*, *3*(4), 322-355. https://doi.org/10.1037/1076-8998.3.4.322
Work Life Balance Inventory	Hayman, J. (2005). Psychometric assessment of an instrument designed to measure work life balance. *Research and practice in human resource management, 13*(1), 85-91.

Perceptions of Fair Interpersonal Treatment Scale	Donovan, M. A., Drasgow, F. & Munson, L.J. (1998). The Perceptions of Fair Interpersonal Treatment scale: Development and validation of a measure of interpersonal treatment in the workplace. *Journal of Applied Psychology, 83*(5), 683-692. https://doi.org/10.1037/0021-9010.83.5.683
Positive and Negative Affect Schedule	Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*(6), 1063–1070. https://doi.org/10.1037/0022-3514.54.6.1063
Stress Appraisal Measure	Peacock, E. J., Wong, P. T. P. (1990). The Stress Appraisal Measure (SAM): A Multidimensional Approach to Cognitive Appraisal. *Stress Medicine, 6*, 227-236. https://doi.org/10.1002/smi.2460060308
COPE Inventory	Carver, C. S., Scheier, M. F., & Weintraub, J. K. (1989). Assessing coping strategies: a theoretically based approach. *Journal of personality and social psychology, 56*(2), 267-283. https://doi.org/10.1037/0022-3514.56.2.267
Utrecht Work Engagement Scale	Schaufeli, W. B., Bakker, A. B., & Salanova, M. (2006). The measurement of work engagement with a short questionnaire: A cross-national study. *Educational and psychological measurement, 66*(4), 701-716. https://doi.org/10.1177/0013164405282471
Recovery Experience Questionnaire	Sonnentag, S. & Fritz, C. (2007). The Recovery Experience Questionnaire: Development and Validation of a Measure for Assessing Recuperation and Unwinding From Work. *Journal of Occupational Health Psychology, 12*(3), 204-221. 10.1037/1076-8998.12.3.204
Larsen and Kasimatis' Symptoms Checklist	Larsen, R. J., & Kasimatis, M. (1991). Day-to-day physical symptoms: Individual differences in the occurrence, duration, and emotional concomitants of minor daily illnesses. *Journal of Personality, 59*(3), 387-423. https://doi.org/10.1111/j.1467-6494.1991.tb00254.x

Appendix E: Overview (work)Stress Scales in Baseline Screening and EMA

Effort Reward Imbalance questionnaire

The Effort Reward Imbalance questionnaire, similar to the JCQ, was used to measure the underlying exposure to work-related stress by identifying an imbalance in the participant's working conditions. The questionnaire is theoretically supported by the ERI model (Siegrist, 1996) and measures work demands (i.e., efforts), rewards, and overcommitment. In exception of one item for efforts (i.e., physical load), all original items were incorporated, including five items for efforts, 11 items for rewards, and six for overcommitment. According to Siegrist et al. (2004) the exclusion of physical load in the efforts subscale, does not influence the psychometric properties of the scale in samples of white-collar workers, including our target population. Answers were scored on a four-point Likert scale (i.e., 1 = *completely disagree*, 2 = *disagree*, 3 = *agree*, 4 = *completely agree*) and ranged from 22 to 88. A sum score was computed for each subscale.

Based on the article by Siegrist et al. (2004), several items were reversed scored to ensure that higher scores indicate higher efforts, rewards, and overcommitment. To estimate an imbalance in efforts and rewards, a ratio was computed by dividing efforts by rewards. The rewards score was multiplied by a correction factor (i.e., 0.4545), calculated by dividing the number of efforts items by the number of rewards items (5/11).

Perceived Stress Scale

The Perceived Stress Scale was developed by Cohen (1983) to measure the overall perception of stress. A 10-items shortened version of this scale was used, for measuring the extent to which recent situations in the participants' lives were appraised as stressful (Cohen, 1994). Answers were rated on a five-point Likert scale (i.e., *0 = Never, 1 = Seldom/Almost never, 2 = Sometimes, 3 = Often, 4 = Very often*) with a range from 0 to 40. Positively stated items were reversed scored so higher scores pointed out a higher level of perceived stress. A sum score of all items was calculated.

Stress Appraisal Measure

The Stress Appraisal Measure was constructed by Peacock and Wong (1990) and aims at assessing the dimensions of primary and secondary appraisal of "*anticipatory stress*" (p. 228). The measuring instrument comprises three subscales for both appraisal dimensions, involving threat, challenge, and centrality for primary appraisal, and the perception of control for secondary appraisal. The latter can be differentiated by "*controllable-by-self, controllable by*

others and uncontrollable-by-anyone" (p. 228) Besides the subscales for appraisal, a subscale was included to measure the overall level of perceived stress (Peacock & Wong, 1990).

In the context of the pilot study and thesis, an 11-item shortened version of the SAM was used, involving only two subscales of primary appraisal (i.e., threat and challenge) and several items from the perceived stress subscale. The threat appraisal defines the perceived threat in terms of potential future losses or harm, and challenge appraisal the foresighted gain from the experience (Peacock & Wong, 1990). The short-version starts with the question *Was there a particular event that created tension in you?*, involving overall perceived stress. It then proceeds with the negatively stated threat subscale and positively formulated challenge dimension. The survey ends with two questions of the perceived stress subscale, with an overlap of the question *Did this overall period create tension in you?*, with the very first question.
The rating procedure follows a five-point Likert scale (0 = *Not at all*, 1 = *Slightly*, 2 = *Moderately*, 3 = *Considerably*, 4 = *Extremely*), with a scoring range from 0 to 44.
The items within each subscale were added up, providing a sum score for each subscale.

Appendix F: Coding Book – Correlation

Coding book - Correlation BS and EMA	
General information	
ID	Number given to the participants in the pilot study (Ranging from 1 to 5)
_R	Recoded
_RR:	Double recoded (e.g. reversed scoring)
B_	Baseline variable
E_	EMA variable
Missing values	
99	Items not included in the day/evening questionnaire
999	Items not asked
9999	Items were visible, but not answered
8	'I have not seen my colleagues or supervisor' (Social support subscale - JCQ)
Value labels	
Subscale 'Sociale ondersteuning' → 8 = 'I have not seen my colleagues or supervisor'	8 will be treated as user missing, therefore it is indicated as missing in spss.* *this was scored in EMA as 4 and was then recoded to 8
Time columns	

TIME	Week, day and measuring moment (based on duration of the study) *e.g. When starting at Tuesday → Tuesday is day one of the study.*
TIME_Days	Days (based on duration of the study
TIME_Weeks	Weeks (based on duration of the study)
TIME_EMA	Ascending numbering of the measuring moments.
TIME_Calendar	Week, day and measuring moment (based on calendar dat) *e.g. Monday is always day 1, 6 and 11*
TIME_Calendar_Days	Days (based on calendar date)
TIME_Calendar_Weeks	Weeks (based on calendar date)
Extra information	
Question: 'Was er een bepaalde gebeurtenis die spanning veroorzaakte?'	Answer NO: Only three items from the stressfulness scale. Answer YES: Two items from Threat scale and two items from Challenge scale.
Recoding of EMA	EMA questionnaire likert-scale data which was had a set point of 0 instead of 1 (like in baseline questionnaires) war recoded to match baseline coding. *e.g. WLB EMA 0-4 → 1-5* *e.g. JCQ EMA 0-3 → 1-4*

Appendix G: Coding Book - Adherence

Coding book - Adherence	
General information - Long Format	
Participant_ID	Number given to the participants in the pilot study (Ranging from 1 to 5)
Questionnaire_Sessions	Ascending number (for each session, per participant)
Time columns - Long format	
TIME_Day	Long format: Days (based on chronological number, ascending from 1) data in in long format
TIME_Day_2	Long Format: Days starting from 1 but only numbering the days with valid data *e.g. a participant's second day only had invalid data; numbering 1 - 3,...*
Session columns - Long Format	
Sessions_Per_Day	Ascending number per day of the number of valid sessions, restarting with 1 every day *e.g. participant 1, on day one session 3 session registered as 1,2,3*
Questionnaire_Sessions	Chronological ascending number of the sessions
Questionnaire_Conditions	There are 6 conditions 1= Morning, without stressful event 2= Morning, with stressful event 3= Daytime, without stressful event 4= Daytime, with stressful event 5= Evening, without physical symptoms 6= Evening, with physical symptoms
Value data - Long Format	

Delay_Response	Time it took to start answering each session after pop-up
Completion_Time_Min	Total time it took to answer the session in minutes
General information - Wide Format	
Participant_ID2	Number given to the participants in the pilot study (Ranging from 1 to 5)
ID_DAYOFF	Number given to the participants in the pilot study (Ranging from 1 to 5) with the addition of the number of total EMAs they completed
Time columns - Wide format	
Total_Days	Total number of valid days participant participated
DayOFF	total number of days of over the course of the data collection
Value data - Wide Format	
Total_EMAs	Total of valid EMA session per participant
B_WLB_WIPL_Mean	Baseline mean value for WIPL
B_WLB_PLIW_Mean	Baseline mean value for PLIW
B_JCQ_JobControl_Mean	Baseline mean value for job controle
B_JCQ_JobDemands_Mean	Baseline mean value for job demand
B_JCQ_DemandsControl_Ratio	Baseline ratio for demands and control
B_JCQ_SocialSupport_Mean	Baseline mean value for overall social support
B_JCQ_SocialSupport_Supervisor_Mean	Baseline mean value for subscale social support - supervisor
B_JCQ_SocialSupport_Colleagues_Mean	Baseline mean value for subscale social support - colleagues

Appendix H: Field Hours Log

UNIVERSITEIT GENT

FACULTEIT GENEESKUNDE EN GEZONDHEIDSWETENSCHAPPEN

Logboek veldwerk

Beschrijving veldwerk	Plaats (UGent of naam externe locatie)	Duur (X aantal uur of minuten)
Mails naar Dr. Nathalie Michels, Prof. Dr. Peter Vlerick en Prof. Dr. Delphine De Smedt voor Nederlandse versie van vragenlijsten en scales.	Thuis	20 minuten
Informatiebrief: Engelse versie + opzoeken questionnaires en scales.	Thuis	1 uur 20 minuten
Opzoeken questionnaires en scales (Engelse en Sloveense versie).	Thuis	2 uur
Ontwikkelen van onderdeel vragenlijst voor baseline screening: - Sociodemografische informatie, - Werkgegevens, - Gezondheid en welzijn: deel roken.	Thuis	2 uur
Ontwikkelen van onderdeel vragenlijst voor baseline screening: - Gezondheid en welzijn: deel alcohol en cafeïnegebruik. - Introductietekst vragenlijst.	Thuis	1 uur
Aanpassen baseline vragenlijst.	Thuis	20 minuten
Vertalen onderdelen baseline vragenlijst.	Thuis	20 minuten

Opstellen EMA vragenlijsten + aanpassen informed consent.	Thuis	4 uur
Aanpassingen Nederlandse Baseline screening survey en controle referenties vragenlijsten deel 1.	Thuis	1 uur 30 minuten
Mail opstellen limesurvey.	Thuis	15 minuten
Controle referenties vragenlijsten deel 2.	Thuis	30 minuten
Referentie controle + Baseline screening en EMA vragenlijst controle op het woord 'leidinggevende'.	Thuis	30 minuten
Vertaling 'confirmation Empatica wristband' en 'ontvangen FNAC bon'.	Thuis	40 minuten
Limesurvey baseline screening vragenlijst – Deelnemer instellingen (inclusief handleiding doornemen).	Thuis	60 minuten
Limesurvey baseline screening vragenlijst – Algemene gegevens + werkgegevens + deel gezondheid en welzijn (inclusief handleiding doornemen).	Thuis	2 uur 30 minuten
Aanpassingen algemene gegevens + vraag over roken.	Thuis	1 uur 15 minuten
Afwerking deel gezondheid en welzijn (30 min).	Thuis	30 minuten
Limesurvey – Effort Reward Imbalance.	Thuis	45 minuten
Limesurvey – Perceived Stress Scale.	Thuis	35 minuten

Limesurvey – Perceptions of Fair Interpersonal Treatment Scale.	Thuis	30 minuten

Limesurvey – COPE inventory.	Thuis	45 minuten
Controle referenties.	Thuis	15 minuten
Vertaling recruitment flyer.	Thuis	20 minuten
Aanpassingen ‘confirmation Empatica wristband’ en ‘ontvangen FNAC bon’.	Thuis	10 minuten
Nederlandse vertaling van Work-Life Balance Scale zoeken.	Thuis	15 minuten
Nederlandse versies van vragenlijsten/schalen van baseline screening en EMA vragenlijst verzamelen en checken.	Thuis	60 minuten
Nederlandse versie Work-Life Balance Inventory zoeken.	Thuis	30 minuten
Vertaling Stress Appraisal Measure - EMA survey.	Thuis	30 minuten
Vertaling/vormgeving Work-Life Balance Inventory.	Thuis	20 minuten
WLB Inventory aanpassen in limesurvey.	Thuis	10 minuten
Limesurvey: aanpassen WLB Inventory, Perceptions of Fair Interpersonal Treatment scale en Recovery Experience Questionnaire.	Thuis	15 minuten
Aanpassing limesurvey: ‘u’ naar ‘je’.	Thuis	60 minuten

Finale controle limesurvey:	Thuis	150 minuten

- Aanpassen Perceived Stress Scale: numerieke score naar Nooit → Erg vaak. - Aanpassen Connor Davidson Resilience Scale: helemaal niet waar/akkoord/van toepassing → helemaal waar/akkoord/van toepassing. - Aanpassen Cope Inventory: Helemaal niet op mij van toepassing → Zeer veel op mij van toepassing. - Aanpassen Connor Davidson Resilience Scale: helemaal niet waar/akkoord/van toepassing → helemaal waar/akkoord/van toepassing. - Aanpassen Recovery Experience Questionnaire: Helemaal niet akkoord → Helemaal akkoord. - Aanpassen Utrecht Work Engagement Scale: Nooit → Altijd/dagelijks.	Thuis	45 minuten
Aanpassen Perceived Stress Scale en Perceptions of Fair Interpersonal Treatment (Array met subvragen). Fout aanpassen in JCQ.	Thuis	40 minuten
Vertalen 'Stay Informed' document.	Thuis	220 minuten = 3u 40 min
Aanpassingen baselinescreening survey.	Thuis	30 minuten

Exporteren van data (Pilootstudie).	Thuis	15 minuten

Flyers technologiecampus odisee hogeschool.	Technologiecampus Odisee Hogeschool	15 minuten
Exporteren data naar SPSS (inclusief handleiding doornemen).	Thuis	30 minuten
Aanpassingen van The Pittsburgh Sleep Quality Index in limesurvey obv feedback pilootstudie.	Thuis	20 minuten
Telefoon met Marc Covents.	Thuis	10 minuten
Uittesten van aanpassingen answercodes.	Thuis	15 minuten
Beoordelingswaarden controleren en aanpassen in limesurvey o.b.v. Wetenschappelijke artikels.	Thuis	45 minuten
Aanpassen 'tip' in limesurvey (The Pittsburgh Sleep Quality Index).	Thuis	5 minuten
Datacleaning – The Pittsburgh Sleep Quality Index; JCQ (gedeeltelijk); Effort-Reward Imbalance Q; Perceives Stress Scale; SF-12; CDRIS; Cope Inventory.	Thuis	9 uur
Aanpassen vraag- en antwoordcodes in limesurvey + Aanpassingen jobonzekerheid en Perceived Stress Scale in *recoded data.*	Thuis	80 minuten
Data-cleaning: extra aanpassingen obv feedback Larissa + Coding book uitschrijven. Coding book uitschrijven.	Thuis	50 minuten 20 minuten

Aanpassingen limesurvey obv feedback.	Thuis	15 minuten
Codingbook.	Thuis	2 uur
Voorbereiden van SPSS document (Eigen schalen baseline screening in long format).	Thuis	50 minuten
Samenbrengen EMA – baseline screening –> 1 participant (om uit te proberen).	Thuis	3 uur
Samenbrengen EMA – Baseline screening van 1 participant (Recoding, reversed scoring, ..).	Thuis	2 uur 30 minuten
Data handmatig ingeven + data ordenen (Correlatie databestand) voor participant 2 en 5.	Thuis	10 uur 30 minuten
Aanpassen databestand correlatie: Tijd volgens kalender (Participant 2 en 5).	Thuis	30 minuten
Totaal aantal uren: ongeveer 69,5 uren		
Gelieve het logboek veldwerk op te laden in Sparta tegen de deadline voor het indienen van de masterproef.		

Approved and signed by co-promotor: Larissa Bolliger (PhD student)

Ghent, 21.05.20

List of figures

Figure 1 A tentative schematic representation of psychosocial pathways. Reprinted from “Psychosocial determinants of health in social epidemiology” by Martikainen, Bartley and Lahelma, 2002, International Journal of Epidemiology, 31, p. 1091–1093. Copyrighted 2002, International Journal of Epidemiology, 31, p. 1091 – 1093. Copyrighted 2002 by Oxford University Press. 11

Figure 2. An overview of a transactional model based on Lazarus’ and Folkman’s (1984) cognitive theory of stress.....15

Figure 3. Job strain model. Reprinted from “Job demands, job decision latitude, and mental strain: Implications for job redesign” by R. Karasek, 1979, Administrative science quarterly, 24, p. 288. Copyright 1979 by JSTOR. 17

Figure 4. Demand-Control-Support Model. Reprinted from “Job Strain, Work Place Social Support, and Cardiovascular Disease: A Cross-Sectional Study of a Random Sample of the Swedish Working Population,” by Johnson and Hall, 1988, American Journal of Public Health, 78, p.1336. Copyright 2014 by ResearchGate. 18

Figure 5. Schematic representation of the ERI-model. Reprinted from uniklinik-duesseldorf website, by J. Siegrist, 2012, retrieved from https://www.uniklinik-duesseldorf.de/fileadmin/Fuer-Patienten-und-Besucher/Kliniken-Zentren-Institute/Institute/Institut_fuer_Medizinische_Soziologie/Dateien/ERI/ERI-Website.pdf Copyright 2012 by University Düsseldorf....19

Figure 6. Overview of job quality indices and their indicators. Reprinted from “Sixth European Working Conditions Survey – Overview report”, by Eurofound, 2017, p.37. Copyrighted 2017 by European Foundation for the Improvement of Living and Working Conditions. 20

Figure 7. Timeline of data collection in the STRAW-Project and pilot study 24

Figure 8. Empatica® wristband used in the study. Reprinted from " the STRAW-Project protocol paper, in progress". Copyrighted 2020 by STRAW-Project.....27

Figure 9. E4 manager. Reprinted from " the STRAW-Project protocol paper, in progress". Copyrighted 2020 by STRAW-Project. 27

Figure 10. Visual representation of perceptions of job demands over different days of data collection....35

Figure 11. Visual representation of perceptions of job control over different days of data collection....35

Figure 12. Visual representation of perceptions of job strain over different days of data collection 36

Figure 13. Visual representation of perceptions of overall social support over different days of data collection 36

Figure 14. Visual representation of social support (supervisor) over different days of data collection 37

Figure 15. Visual representation of social support (colleagues) over different days of data collection 37

Figure 16. Boxplots – distribution of the perception of job demands per week 40

Figure 17. Boxplots – distribution of the perception of job control per week 41

Figure 18. Boxplots – distribution of the perception of job strain per week 41

Figure 19. Boxplots – distribution of the perception of overall social support per week 42

Figure 20. Boxplots – distribution of the perception of social support from supervisor per week 42

Figure 21. Boxplots – distribution of the perception of social support from colleagues per week 43

Figure 22. Job demands - Visual representation of the correlation between baseline and day-to-day perceptions 46

Figure 23. Job control - Visual representation of the correlation between baseline and day-to-day perceptions 46

Figure 24. Job strain - Visual representation of the correlation between baseline and day-to-day perceptions 47

Figure 25. Overall social support - Visual representation of the correlation between baseline and day-to-day perceptions 48

Figure 26. Support from supervisor - Visual representation of the correlation between baseline and day-to-day perceptions 49

Figure 27. Support from colleagues - Visual representation of the correlation between baseline and day-to-day perceptions 49

Figure 28. Distribution of total valid days of participation per participant 54

Figure 29. Distribution of total completed EMAs per participant 55

Figure 30. Distribution of completed EMAs per day based on participant ID 55

Figure 31. Distribution of days off per participant 56

Figure 32. Boxplots - Distribution of completion time for morning questionnaires without stressful events 59

Figure 33. Boxplots - Distribution of completion time for morning questionnaires with stressful events 60

Figure 34. Boxplots – Distribution of completion time for daytime questionnaires without stressful events according to participant ID 61

Figure 35. Boxplots – Distribution of completion time for daytime questionnaires with stressful events according to participant ID 62

Figure 36. Distribution of delay in response according to participant ID 63

Figure 37. Correlation between the number of completed EMAs per day according to baseline perceptions of job demands 66

Figure 38. Correlation between the number of completed EMAs per day according to baseline perceptions of job control 67

Figure 39. Correlation between the number of completed EMAs per day according to baseline perceptions of job strain 67

Figure 40. Correlation between the number of completed EMAs per day according to baseline perceptions of overall social support 68

Figure 41. Correlation between the number of completed EMAs per day according to baseline perceptions of social support from supervisor 68

Figure 42. Correlation between the number of completed EMAs per day according to baseline perceptions of social support from colleagues 69

List of tables

Table 1. Overview of colour codes for specific conditions 30
Table 2. Basic socio-demographic characteristics of the study sample 32
Table 3. Basic socio-demographic characteristics of the study sample 33
Table 4. Descriptive results of perceptions of JCQ dimensions over time (weeks) 39
Table 5. Results of multi-level analyses on correlation between EMA and Week 44
Table 6. Multi-level analyses results of correlation between JCQ dimensions Baseline and EMA 45
Table 7. Results full factorial model – correlations between Week – EMA and Baseline – EMA 51
Table 8. Results full factorial model – Interaction between Baseline and Week 52
Table 9. Results random intercept model for association time – EMA and baseline – EMA 53
Table 10. Descriptive statistics - Completion time of morning questionnaires with and without stressful events according to participant ID 57
Table 11. Descriptive statistics - Completion time of daytime questionnaires with and without stressful events according to participant ID 58
Table 12. Time delay in response (minutes) according to participant ID 62
Table 13. Spearman correlations between EMAs per day and baseline perceptions of job demands, control and job strain 64
Table 14. Spearman correlations between EMAs per day and baseline perceptions of social support – overall, supervisor and colleagues 65