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Software professionals during the COVID-19 pandemic in Turkey: Factors affecting their mental well-being and work engagement in the home-based work setting

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ABSTRACT

With the COVID-19 pandemic, strict measures have been taken to slow down the spread of the virus, and consequently, software professionals have been forced to work from home. However, home-based working entails many challenges, as the home environment is shared by the whole family simultaneously under pandemic conditions. The aim of this study is to explore software professionals' mental well-being and work engagement and the relationships of these variables with job strain and resource-related factors in the forced home-based work setting during the COVID-19 pandemic. An online cross-sectional survey based on primarily well-known, validated scales was conducted with software professionals in Turkey. The analysis of the results was performed through hierarchical multivariate regression. The results suggest that despite the negative effect of job strain, the resource-related protective factors, namely, sleep quality, decision latitude, work-life balance, exercise predict mental well-being. Additionally, work engagement is predicted by job strain, sleep quality, and decision latitude. The results of the study will provide valuable insights to management of the software companies and professionals about the precautions that can be taken to have a better home-based working experience such as allowing greater autonomy and enhancing the quality of sleep and hence mitigating the negative effects of pandemic emergency situations on software professionals' mental well-being and work engagement.

1. Introduction

On January 30, 2020, COVID-19, a viral illness, was declared a public health emergency situation by the WHO (2020). Consequently, it became a pandemic that affected millions of people, and this situation guided governments to take strict measures, such as ordering lockdowns and closing government and private businesses and all public spaces, including schools, to slow down the spread of the virus. Hence, most employees of public institutions and private companies were faced with obligations, such as working from home. Similarly, in early March, online education and general curfews for various periods of time zones were declared in Turkey for citizens over the age of 65 and under the age of 20, to be held for an uncertain period (Agency, 2020). Employees of companies and governmental offices were forced to work remotely as part of the measures starting from the early days of the pandemic (Anadolu Agency, 2020). Additionally, travel bans and quarantines for returning nationals were announced (Bakir, 2020).

With the measures undertaken during the pandemic, the home environment has become an office for parents, a school for children, and a living space for the whole family at the same time. Therefore, the issues addressed in previous studies on home-based working conditions are yet to discover a new dimension with the requirements introduced by the COVID-19 pandemic. The topics covered in the current studies on software practitioners' home-based working focus primarily on productivity issues, challenges, and well-being during the COVID-19 pandemic (Ralph et al., 2020; Anselmo Da Mota et al., 2021) but many questions remain to be examined on the forced home-based work setting experience of software professionals in terms of their mental well-being, work engagement and protective factors that shape the current research.

As software development, by its nature, requires a great deal of concentration and focused attention (Capretz and Ahmed, 2010), software workers have to spend long hours performing challenging tasks (Hyman et al., 2003a; Meyer et al., 2017). They need to be creative, systematic, persistent, and need to stand for stress (Capretz and Ahmed, 2010; Acuña et al., 2006). Especially when the deadlines are demanding, it can be challenging for a software professional, to turn off the computer at the end of the

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workday and switch to the private life (Hyman et al., 2003a; IOSH, 2014) in the home-based working arrangement that may result in more work pressure and may be associated with stress and eventually psychological diseases, such as burnouts (Zulfany et al., 2019).

Among other advantages such as flexibility and better concentration, home-based working has been considered to contribute to the well-being of employees as well (Wheatley, 2012). However, during the pandemic, all family members may coexist and share the home environment where employees need to concentrate and perform their daily work routines while taking care of their kids who are participating in online lectures. Additionally, as software companies are caught unprepared for remote work arrangement, they have difficulties in directing the employees' workload properly which might have caused additional pressure on software practitioners (Anselmo Da Mota et al., 2021). Accordingly, as software practitioners are the competitive power of the software business (Reyt and Wiesenfeld, 2015), their mental well-being, which may affect project success, and work engagement, which shows the dedication to the work tasks, during pandemic deserve special attention which is the focus of the current study.

Anything that contributes to the attainment of goals perceived by an individual is referred to as a resource (Halbesleben et al., 2014) which serves as an enabler for employees to complete their job activities and contribute to their well-being and performance such as health, ability to communicate well or motivation to get things done (Hobfoll, 1989; Balducci et al., 2011). During the pandemic, home-based working might have required usage of one's resources for both home and work-related issues which forced individuals to build balance in between. Particularly, the challenges introduced by pandemic has led to additional levels of stress for software developers (Anselmo Da Mota et al., 2021). This might have consumed the available resources that might lead to exhaustion both at home and work-related issues and hence the results obtained in previous studies of home-based working may not apply to the current "home-based" working of software professionals. Therefore, the mental well-being and work engagement of software professionals working under pressured project timelines and their resources deserve further research during the pandemic. Hence, the current study intends to explore the predictive factors of software professionals' mental well-being and work engagement under the new normal, during the COVID-19 pandemic. Hence, the general research question is:

> "How are software professionals' mental well-being and work engagement related to job strain and resource-related factors (i.e. sleep quality, decision latitude, work-life balance and exercise) during their home-based working experience in the times of COVID-19 pandemic?"

The present research utilizes a survey instrument in order to understand the effects of job strain and resource-related variables as sleep quality, and having decision latitude, work-life balance, and having exercise on mental well-being and work engagement of software professionals in Turkey during pandemic home-based working. The former group of variables is conceptualized as replenishers of depleted psychological resources during pandemic home-based working.

Concerning the studies conducted in the software engineering domain during the COVID-19 period, this study is among the several studies exploring the predictors of mental well-being, and to the best of the author's knowledge, it is the first investigating the predictors of work engagement of software professionals in home-based work setting during COVID-19 pandemic.

As it is predicted that new cases of pandemic periods are inevitable in the foreseen future (Morens and Fauci, 2013), the results of this study will provide valuable insights to the management of the software companies and to the software professionals about the precautions that can be taken to mitigate the negative effects of emergency situations on software professionals' mental well-being and work engagement. As such a broad epidemic and as a result extensive lockdowns and forced home-based working have not been encountered before in the software world, addition to the limited number of COVID-19 studies in the software engineering domain, research findings from other domains are considered as well to build the hypotheses and discuss the obtained results.

2. Background

In this section, the studies on the effect of pandemic on software practitioners, mental well-being, and work engagement are investigated. Additionally, job strain and resource-related factors; namely, sleep quality, decision latitude, work-life balance, and exercise and their relation with respect to mental well-being and work engagement are explored.

Effect of the pandemic on software professionals

As in other sectors, workers of the software industry were affected by the COVID-19 measures. Several researches have been conducted during this period to examine the impact of pandemic on software professionals. One of the earliest studies addresses the productivity and well-being of software professionals through a multi-cultural survey of 2225 participants which has revealed that pandemic has an adverse influence on the well-being and productivity of software developers (Ralph et al., 2020).

In the longitudinal study of Russo et al., 2021b, the predictive factors of well-being and productivity were explored with 192 software professionals, and factors such as the need for autonomy and competence, stress, and sleep quality were found to be associated with well-being and boredom and distractions are found to predict productivity. Similarly, Bao et al. (2020) performed a field study where they collected daily development activities of 139 software developers. These people both worked from home and office and reported that home-based working has an adverse effect on productivity in large projects.

Butler and Jaffe (2020) collected daily diaries of volunteer Microsoft employees over a 10-week period and gathered data related to their challenges and things they were grateful for. The employees reported that among other factors, increased number of meetings, overworking and both physical and mental health were the most challenging ones. The experiences of software engineers at Microsoft were explored in another study where 3634 responses were gathered (Ford et al., 2020). Several factors related to home-based working such as flexible work hours, better focus time, more comfortable clothing that affected engineers differently were identified.

Russo et al. (2021a) analyzed the daily activities of 200 software professionals and compared them with respect to the pre-pandemic period. They explored the relationship of well-being, productivity, and other psychological and social variables related to developers' work and concluded that home-based work is not a challenge for software developers. In their work, Smite et al. (2021) interviewed 18 software developers to understand how their code production performance and daily activities have changed during the pandemic home-based working period. The results suggest that developers attuned themselves gradually to the pandemic situation and hence pandemic did not have any major effect on developers' daily activities and code productions. In addition to these, Anselmo Da Mota et al. (2021) explored the effect of pandemic on software projects and software professionals. They mined the GitHub project repository and conducted a survey on 279 software professionals. They did not find a certain

trend in change in productivity which was also concluded in the study of Smite et al. (2021) where 18 software practitioners were interviewed on different dimensions of productivity in a company setting. Additionally, Thorstensson (2020) explored factors that impacted IT project managers' productivity and concluded that home-based work has both positive and negative effects on productivity.

As seen from the studies performed on the effect of pandemic on software professionals, productivity and well-being are the prominent parameters explored mostly. The studies focusing on productivity describe contradicting results. Among those, adverse effect of the pandemic on productivity was reported (such as Ralph et al., 2020; Russo et al., 2021b) whereas no notable effect of the pandemic on productivity is mentioned as well (such as Anselmo Da Mota et al. (2021), Bao et al. (2020), Smite et al. (2021) and Thorstensson (2020)). However, there seems to be a consensus that well-being has been affected negatively by the home-based setting during the pandemic (Ralph et al., 2020; Russo et al., 2021b). Additionally, home-based work setting and challenges faced by software professionals during pandemic were explicitly explored (Butler and Jaffe, 2020; Ford et al., 2020) giving possible insights on how to improve home-based work.

Consequently, the number of studies that investigate software professionals' mental well-being during pandemic home-based work settings is quite scarce and to the best of the author's knowledge, there is no study that explores software professionals' work engagement explicitly during pandemic. Hence, this study investigates the predictors of mental well-being and work engagement of software practitioners during pandemic home-based working.

Mental wellbeing and work engagement

Being forced to home-based working with other family members because of the strict pandemic measures has affected the daily routines of software professionals as other workers. Especially because of curfews and lockdowns during the pandemic that led to intensive use of IT technologies, most of the software developers reported that they had to work harder (Butler and Jaffe, 2020) and have to face many challenges (Anselmo Da Mota et al., 2021; JRebel, 2020; Russo et al., 2021b; Smite et al., 2021). Hence, exploring parameters of mental well-being and work engagement and how they are related to job strain and resource-based factors during pandemic would enhance our understanding on the effect of pandemic on software practitioners. Accordingly, the main dependent variables investigated in this study are mental well-being and work engagement of software practitioners.

Mental well-being is related to satisfaction with life, positive and negative emotions, and meaning in life (Dolan and Metcalfe, 2012; Diener, 2006), and it is defined as the mental state of an individual in terms of feelings, thoughts, and ways of coping with daily life. The mental well-being of employees affects their performance and productivity, which has unavoidable consequences on the competitiveness of businesses. The software development process is quite demanding and requires concentration, creativity, analytical thinking, and decision-making ability in stressful work settings (Acuña et al., 2006). The well-being, happiness, and work settings of software professionals have a remarkable effect on the quality of the output, their motivation, and hence on the success of the whole software development process (Nakata, 2017; Nieminen, 2019; Sharp et al., 2009). The prediction of the software developers' well-being could be possible through individual prediction models (Kuutila et al., 2021).

The other dependent variable, work engagement, shows the degree of the devotion of a worker in the task performed, which is expressed by dimensions of vigor, dedication, and absorption (Schaufeli et al., 2002). Work engagement is a significant parameter connected to performance (Kahn, 1990) which enables workers to produce valuable outputs even in stressful work environments (Britt et al., 2001). Employees with high work engagement exert high levels of energy and devotion at work (vigor), feel importance and relevance (dedication), and concentrate more (Bakker et al., 2008). Work engagement is associated with personal resources at work, hence encompasses dynamic characteristics of well-being (Ouweneel et al., 2012) and was demonstrated to be connected with work outcomes in terms of workforces and organizations (Bakker and Albrecht, 2018). Supportively, the results of the study of 304 Indian IT professionals showed that work engagement was associated with organizational effectiveness (Kataria et al., 2014). Additionally, the study performed with South African software developers revealed that flexible work arrangement was associated with improved engagement and performance (Conradie and de Klerk, 2019).

Employees with higher levels of engagement indicated to have positive mental and physical states (Bakker et al., 2014). For instance, Milikic and Cuckovic researched 97 employees of the Serbian ICT sector and explored if work engagement has an effect on job satisfaction and organizational commitment (Milikić and Čučković, 2019). They concluded that applying suitable work engagement interventions may have a positive effect on job satisfaction and the organizational commitment of employees. Similarly, positive effects of work engagement on software developers' well-being are reported by Graziotin et al. (2018).

As mental well-being and work engagement are two critical factors for anticipated personal and organizational outcomes and envisioned to be affected during pandemic home-based work setting, this study considers the factors (i.e. job strain, sleep quality, decision latitude, work-life balance, and exercise) as replenishers of reduced psychosocial resources and investigated their relationship with aforementioned dependent variables.

Job strain and resource-related factors in the home-based work setting

Research has mentioned the negative effects of isolation and quarantine such as stress among the community (Sprang and Silman, 2013). Consequently, during the pandemic, uncertainty and unfamiliarity with the situation might have diminished the benefits of home-based work setting that are mentioned in previous studies (Wheatley, 2012; Conradie and de Klerk, 2019). Hence, additional research is needed for better understanding the constitutes of effective home-based work experience in terms of mental well-being and work engagement of software practitioners. Consequently, job strain, resource-related factors of sleep quality, decision latitude, work-life balance, and exercise are considered as predictors to examine the degree with which these factors play role in software professionals' mental well-being and work engagement during the pandemic. These factors are explained below and associated theories are highlighted to build the hypotheses.

Job strain

Job strain is a type of stress that occurs in the workplace. The adverse effects of stress on both physical and mental conditions and hence on organizational performance are well known. For example, cardiovascular problems, anxiety, and depression may develop after long periods of exposure to job strain (Honkonen et al., 2006; Beehr and McGrath, 1992; Nyberg et al., 2013; Grunberg et al., 1999). Moreover, individuals experiencing work-related stress may experience adverse effects such as alcoholism, insomnia, and sexual difficulties which results in negative work outcomes such as absenteeism and reduced productivity, and increased turnover (Grunberg et al., 1999; Windeler et al., 2017; Krysinska and Lester, 2010; Graziotin et al., 2017). Work-related stress could also cause less dedication and less focus on job

activities. Accordingly, job strain and work engagement are found to be negatively associated (Amin et al., 2018).

One of the most well-known models of job strain was developed by Karasek et al. which considers workload and job demand control for assessing stress at work (Karasek et al., 1981), and is referred to as job strain. It is reported that the worst work circumstances happen when there is a high workload and low job demand control with no available social support, which results in high job strain. Hence the social support factor was included in the job strain model (Johnson and Hall, 1988; Johnson et al., 1989).

Particularly, software development requires developers to perform various tasks with different roles hence they are forced to manage their resources in handling activities properly resulting in complications (Liu et al., 2011). The nature of activities of software development life cycle necessitates collaboration between software professionals where they continuously communicate with each other, exchange and share data, resources, and ideas which may contribute to higher levels of stress (Lindsjørn et al., 2016) and as a result may affect project success, as well. In the study of software development teams of 180 participants, work stressors were found to be positively associated with burnout measures (Sonnentag et al., 1994). In another study that explores stress, empowerment, and performance in agile teams, it is revealed that empowered teams handle stress better (Laanti, 2013).

In many studies, affective states, such as well-being, feelings, and emotions of software professionals were shown to be connected with their work performance (Shaw, 2004; Graziotin et al., 2014; Khan et al., 2011). Accordingly, it is shown that stress has adverse effects on both developers and hence on positive work outcomes and is a quite common problem among software professionals (Windeler et al., 2017; Graziotin et al., 2017; Liu et al., 2011) that has prolonged negative effects (Windeler et al., 2017; Lovallo, 2005). For example, in the study of 372 software developers, it is found that excess levels of work stress affected the developer's mental health negatively (Singh and Suar, 2013).

Job strain was also listed as a factor affecting individuals in home-based work settings (Hyman et al., 2003b). It is also revealed that remote work during the pandemic could lead to burnouts among software practitioners because of continuous working with insufficient breaks and long tiring virtual meetings (Butler and Jaffe, 2020; Smite et al., 2021). Supportively, it is also mentioned that, working from home exclusively may have adverse effects on both the mental and physical health of software developers which may signal a possible breakdown (GitHub Data Science Team, 2020). Likewise, the benchmark report of software assurance authority, Software Improvement Group (SIG) analyzed more than 6000 systems worldwide in SIG Sigrid® software assurance platform and revealed a decrease in average coding effort during the pandemic with respect to the previous year (Software Improvement Group, 2021). The report pointed out that build quality performance was also dropped. Additionally, software practitioners reported less attention and concentration to their work during the home-based working period as mentioned to be the underlying factors of this decline (Software Improvement Group, 2021) which may herald work disengagement from work activities during the pandemic. Additional to the workload pressures, forced home-based work during the pandemic is also reported to change social interactions among software practitioners as well (Smite et al., 2021) which is considered as the worst work circumstance according to the job strain model (Johnson and Hall, 1988; Johnson et al., 1989).

Conservation of Resources (COR) theory is extensively used for explaining burnout (Hobfoll, 2011) which states that when the resources an individual possess are reduced or endangered, he or she may try to preserve them to prevent more loss (Hobfoll, 1999). It provides a model for preventing resource loss, preserving present resources, and gaining resources needed for engaging in proper behaviors. According to the conservation of resources theory (Hobfoll, 1989), employees' divergent behavior at work may be linked to loss or thread to one's resources as a consequence of stressors at work such as executive politics, formalities, and role uncertainty (Lepine et al., 2004; Fox et al., 2001). Supportively, a positive association between stressors at work and divergent behavior which was shown through empirical studies (Eschleman et al., 2015; Zhang et al., 2014; Penney and Spector, 2005) are linked to undesirable emotions (Matta et al., 2014; Yang and Diefendorff, 2009). Additionally, Conservation of Resources (COR) theory points out that the primary motivation of the individuals that is to construct, defend, and nurture their resources, are crucial mechanisms that define their perceptions of stress and their coping strategies for it in order to safeguard the self and the societal connections that support the self (Buchwald and Schwarzer, 2010). Such coping mechanisms may result in mental and physical exhaustion (Kristensen et al., 2005; Maslach, 2003) and hence may associate with disengagement from work activities (Schaufeli and Greenglass, 2001).

Especially with the negative influence of pandemic on workers resulting in reduced resources, the effect of software professionals' job strain on mental well-being and work engagement requires further investigation. Hence, based on the conservation of resources (COR) theory, the following hypotheses are posed for software professionals:

H1. Job strain predicts software professional's current mental well-being negatively.

H2. Job strain predicts software professional's current work engagement negatively.

Sleep quality

Sleep quality embraces both quantifiable and objective characteristics of sleep, like length, or latency, and subjective features like depth (Buysse et al., 1989) which is an important factor in modern cultures as deprived sleep quality is a growing problem (Butz and Stahlberg, 2018). The positive effect of high sleep quality on well-being is reported as it improves inadequate governing resources and enables self-control mechanisms (Barber et al., 2009; Beebe and Gozal, 2002). Accordingly, low sleep quality is mentioned to be related to discrepancies in self-control mechanisms (Ghumman and Barnes, 2013) and hence results in low mental well-being (Barber et al., 2009). Similarly, reduced sleep duration causes discrepancies in self-control such as diminished decision-making capability, and attention management (Chuah et al., 2006). Disrupted sleep is shown to have a negative effect in the workplace such as low productivity as well (Wagner et al., 2012; Christian and Ellis, 2011). Similarly, the adverse effect of one-night sleep deprivation of novice developers on software development tasks is shown which is found to impact software development quality negatively (Fucci et al., 2020). Low sleep quality disconcerts decision processes and limits one's capacity for emotional regulation and is found to be a valuable reserve for daily work engagement of workers (Kühnel et al., 2017).

Even though home-based working can produce desirable work outcomes, it could have adverse effects on the employees such as higher degree of work pressure and work-life imbalance (Russell et al., 2009) which can magnify software practitioners' stress at work and home that may resemble itself as insomnia or burnout (Hyman et al., 2003a).

The isolation through lockdowns and forced home-based working that resulted in amplified levels of stress would affect the sleep routines of software professionals which, as a valuable personal resource, could also affect well-being (Chow, 2020)

and work performance (Barnes and Wagner, 2009). Accordingly, an increased level of sleep disorder was mentioned by software practitioners during the pandemic (Anselmo Da Mota et al., 2021). Likewise, the stress pandemic caused has shown to affect sleep quality and created instability in family life (Islam et al., 2020). Hence sleep quality is considered a resource-based factor. Specifically, poor sleep quality could result in the loss of self-regulatory resources and hence exhaustion, which may result in low engagement in work activities and low mental well-being of software professionals. Hence, based on the conservation of resources (COR) theory, the following hypotheses are proposed:
H3. Sleep quality predicts software professional's current mental well-being positively.
H4. Sleep quality predicts software professional's current work engagement positively.

Decision latitude

Decision latitude of job control refers to the capability of a worker's control over the daily tasks performed at work (Karasek, 1979) that enables controlling of work events and activities, usage of creativity and competence, and gripping new skills. By enabling authority in task-relevant decisions (Westman, 1992), it may mitigate the adverse effects of job stress of employees (De Lange et al., 2003), influences well-being (Karasek, 1979), and allows work engagement (Hu et al., 2011). Among other factors, job decision latitude (JDL), through job autonomy and skill utilization and development (Karasek et al., 1981; Karasek, 1979), is shown to be a strong predictor of work engagement and contrariwise (de Lange et al., 2008; Schaufeli et al., 2009; Xanthopoulou et al., 2009).

Decision latitude is a necessary resource that enables goal setting and supports individuals in managing problematic tasks or high workloads (Hacker, 2003) and is reported to attenuate stress in the workplace (Karasek and Theorell, 1990). Decision latitude, through autonomy to control activities at work, would support the development of coping strategies to handle the negative effect of job stress (Gunavathy and Thenmozhi, 2009) hence, high levels of autonomy at work is linked to positive employee outcomes (Elsass and Veiga, 1997) and well-being (Calvo et al., 2020). Accordingly, low levels of decision latitude and job strain is shown to affect employees' well-being (Theorell et al., 2015). As workers may realize the need for autonomy through decision latitude (Bakker et al., 2008), it enhances work engagement and motivation as a result (de Lange et al., 2008; Xanthopoulou et al., 2009; De Witte et al., 2007; de Lange et al., 2009).

Even though home-based working would strengthen employee autonomy and hence may serve for employee well-being and engagement, it may cause psychological burden for some workers with unbalanced affective states (Perry et al., 2018). Pandemic is reported to deepen or speed up the levels of psychological disorders (Dubey et al., 2020). Hence, being a resource-related factor, the relation between decision latitude, mental well-being, and work engagement of software professionals during pandemic home-based working needs further research. Having decision latitude in one's job may support replenishment of resources and hence may lead to an improved level of engagement in work activities and mental well-being of software professionals. Hence, drawing from conservation of resources (COR) theory, it is hypothesized that as a resource-related factor job decision latitude would predict worker's engagement and mental well-being positively.
H5. Having decision latitude in one's job predicts software professional's current mental well-being positively.
H6. Having decision latitude in one's job predicts software professional's current work engagement positively.

Work-life balance

Work-life balance is experienced when an individual can allocate personal resources like energy, and time effectually to different life areas (Kalliath and Brough, 2008). Hence, conflict occurs between these two worlds when limited resources cannot meet the opposing demands (Edwards and Bagozzi, 2000). Balancing work and family responsibilities is a growing challenge for most of the employees. Particularly, in the last two decades, the borderline between individual's work and life contexts has become quite unclear because of the changes in the family structures, women's involvement as labor force, and teleworking opportunities (Peeters et al., 2005).

Even though home-based working is shown to produce desirable work outcomes, it could have adverse effects on the employees such as higher degree of work pressure and work-life imbalance (Russell et al., 2009). The lack of work-life balance has been shown to have damaging consequences such as low life and job satisfaction, somatic symptoms (Mesmer-Magnus and Viswesvaran, 2005), worsened health and well-being (Allen et al., 2000), and low performance at work (Gilboa et al., 2008). Particularly, the stress pandemic caused has been shown to create instability in family life (Islam et al., 2020). Hence exploring the relationship between work-life balance, mental well-being, and work engagement, in the specific context of the pandemic, would enable our understanding of software practitioners' home-based work experience further.

The conflicts between work and life contexts consume one's limited resources and lead to deteriorated self-control (Baumeister et al., 1998). This may affect an individual's behavior and mental and physical health that is connected to organizational performance as well. In a high work-life imbalance situation, an individual needs to answer to the conflicting demands (Ford et al., 2007) which may result in exhaustion of personal resources (Sonnentag and Zijlstra, 2006). During forced remote work arrangement, some of the software practitioners faced challenges in balancing work and private life and concentrating their daily work (Smite et al., 2021). According to the conservation of resources (COR) theory, individuals try to preserve their resources or reduce them when they are exhausted or they feel their resources are threatened (Hobfoll, 1989). Consequently, when work-family imbalance may result in exhaustion of resources, individual may withdraw from work responsibilities that results in low work engagement. Previous studies have shown that work engagement and work-life balance constructs are related as well (Ilies et al., 2017; Vîrgă et al., 2015; Shankar and Bhatnagar, 2016; Parkes and Langford, 2008).

Drawing from COR theory, considering work-life balance as a resource-related factor that would affect mental well-being and work engagement of software professionals, the following hypotheses are posed:
H7. Work-life balance predicts software professional's current mental well-being positively.
H8. Work-life balance predicts software professional's current work engagement positively.

Exercise

Physical exercise is an activity performed to pursue physical fitness and hence overall health. The effect of exercise ranges from positive biological changes (Dietrich and McDaniel, 2004; Querido and Sheel, 2007) to enrichments in cognitive functioning (Huang et al., 2016), quality of life (Pedrinolla et al., 2017) and mental well-being (Zubala et al., 2017; Malcolm et al., 2013; Fox, 1999; Kenneth, 1999).

Earlier research has strong evidence on the positive benefits of exercise both on physical and as a consequence on the psychological health of people at any age (Fernandes et al., 2017;

Chieffi et al., 2017; Pereira et al., 2007). The connection between biological and psychological factors related to exercise is a very well-known finding which improves the well-being of individuals (Penedo and Dahn, 2005).

Several researches report the effectiveness of exercise in the improvement of mental well-being and several positive effects of exercise on several positive well-being factors, such as mood and anxiety have been specified (Neill et al., 2020; Gothe et al., 2021; Calfas and Taylor, 2016). Particularly, health and well-being have significant effects on employees, as well as on the organization in which they work (Danna, 1999) as it helps them to recover from the negative psychological effects generated during the day (Sonnentag, 2001). Exercise can be referred to as an important resource for the well-being of employees which serves for improved performance (Nägel et al., 2015). In the work setting, the positive effect of regular exercise on employees' well-being has been shown (Shephard, 1996) and the connection between exercise and mental well-being is mentioned as well (Thøgersen-Ntoumani et al., 2005).

The connection between exercise and work engagement has been researched in several studies which have found contradicting results. While exercise is shown to be connected to work engagement (Nishi et al., 2017) as its physiological effects result in improved well-being, reduced stress, burnout, sickness absenteeism, and presentism (Strijk et al., 2013; Michishita et al., 2017), other studies found no effects of health-promoting interventions on work engagement (Oude Hengel et al., 2012). However, Strijk et al. found a significant effect of a yoga program on the vigor sub-component of work engagement (Strijk et al., 2013).

According to broaden-and-build theory, the positive emotions developed following the exercise may expand one's variety of thoughts and actions and permit personal resources to be constructed (Fredrickson, 2001). Particularly, positive emotions such as joy, interest, and contentment broaden one's thought-action repertoire that would lead to improved problem-solving capability by providing a wider perspective to handle stressors effectively (Fredrickson, 2000). Moreover, the construction of persistent resource reserves to handle upcoming challenges would be possible (Fredrickson, 2001). In the scope of pandemic home-based working, people who apply healthy lifestyle interventions such as exercise would develop better coping strategies by building lasting resource reserves that would affect software practitioners' mental well-being and work engagement. Especially, forced isolation, lockdowns, and decreased number of social activities at work may lead to low levels of physical activity as reported by software practitioners (Smite et al., 2021) that would impact their resources negatively. Hence, based on the conservation of resources (COR) and broaden-and-build theories, the following hypotheses are posed for software professionals:

H9. Exercise predicts software professional's current mental well-being positively.

H10. Exercise predicts software professional's current work engagement positively.

Although the relationships among job strain and resource-related factors and mental well-being and work engagement were researched in various studies and various contexts, this study will provide a new perspective on the relationship among these factors as it addresses challenges introduced by COVID-19 on the home-based working of software professionals.

3. Method

The current research was conducted as an online survey to explore factors contributing to the mental well-being and work engagement of software professionals during the pandemic that followed the guidelines specified by Kitchenham and Pfleeger (2008). Survey including questions on sociodemographic characteristics, home-based work-related parameters during COVID-19, validated scales related to the participants' mental well-being, work engagement, sleep quality, work-related psychosocial characteristic of job strain and decision latitude and close-ended questions for work-life balance and physical exercise habits, was administered which were all in Turkish.

3.1. Participants

The pool of participants consisted of 321 volunteer software professionals who accessed the survey through an e-link that was posted on social media channel groups of software professionals in Turkey between May 18 and June 11, 2020. The purposive sampling method was applied, and the electronic survey tool Google Forms was used. Informed consent was given by each participant. A total of 362 software professionals responded to the questionnaire, and 321 valid responses were obtained. The responses of full-time home-based workers (29 responses), repeated data (4 responses), and non-home-based workers (8 responses) were excluded in the analysis. 69% (220) of the participants were male with an average age of 35.1 (aged 23 to 68 years old, $Mdn = 34$), whereas women constituted only 31% (101) of the respondents with an average age of 33.4 (aged 22 to 51 years old, $Mdn = 33$).

48% of the respondents were married and 52% were single. The remaining (3%) selected the 'other' option. Regarding the living situations, most of the participants (61%) reported living with their family, 21% of them reported living alone, 13% reported living with elder family members and the remaining 6% of them reported the 'other' option. Concerning education level, the distribution was as follows: 58% had bachelor's degree, 38% had master's degree, and the remaining, less than 1%, reported having a Ph.D. degree. Most of the participants (87%) indicated working for a private company followed by 9% who were employed at a public organization. The majority of the participants (64%) worked for companies with lower than 250 employees and the remaining ones worked for companies with 250 and higher numbers of employees. Regarding the position, 16% of the respondents specified their position as engineers, 33% were specialists, 23% were senior specialists, 18% were managers, 6% were directors, and the remaining 4% chose the 'other' option.

3.2. Measures

Sleep quality

The Pittsburgh Sleep Quality Index (PSQI) assesses sleep quality over 19 items. It is developed by Buysse et al. (1989) and adapted by Ağargün et al. to Turkish (Cronbach's $\alpha = 0.80$) in which 19 items are processed to calculate 7 component scores which are subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction (Ağargün et al., 1996). Four of the questions are open-ended and the rest are rated based on a 4-point Likert scale. The sum of the scores for these seven components results in a final score for the PSQI scale (Buysse et al., 1989).

Job strain and decision latitude

For work-related psychosocial components namely job strain and decision latitude, the 17-item Demand-Control-Support Questionnaire (DCSQ) was employed. The DCSQ scale was developed by Karasek and colleagues (Karasek et al., 1998) with three dimensions: work demands (e.g., "Does your job require you to work very hard?"), decision latitude (e.g., "Do you have the opportunity to learn new things in your work?"), and social support at work (e.g., "People at work understand that I may have a "bad" day") on a 4-point Likert scale (1 = never, 4 = often). The

4th and the 9th items were reverse coded. Higher scores indicate higher work demand, decision latitude, and perceived social support at work. In this scale, the interaction of work demand and decision latitude defines the job strain level where job strain is calculated by division of work demand by decision latitude and high strain is considered for >1 values (Karasek et al., 1981, 1998). Turkish version of the scale is proved to be a valid and reliable instrument by Demiral and colleagues (Demiral others, 2007) and each dimension yielded a sufficient reliability score (Cronbach's α = 68, .78, .77, respectively). Sufficient internal consistency value was gathered in the current study (Cronbach's α = .60, .69, .79, respectively).

Work-life balance

One close-ended question was created by the author and asked to assess the ability of separating work and private life as follows: "I can separate the work and private life". (0 = no, 1 = yes)

Exercise

Two open-ended questions were created by the author and asked to assess the habits of physical exercise: "Approximately how many times did you do exercise in a week during home-based working?" and "Approximately how many times did you do exercise in a day during home-based working?". A composite score was created for these two items by averaging the numerical responses given. Higher scores indicate higher time allocated to exercise.

Mental well-being (General Health Questionnaire)

Mental well-being was measured by the short version of the General Health Questionnaire (GHQ-12) scale. GHQ is developed by Goldberg and Williams (1988) and has been widely used as a brief assessment tool to assess mental health (Goldberg and Williams, 1988; Goldberg others, 1997). The Turkish version of the scale is proved to be valid and reliable by Kılıç with sufficient internal consistency (Cronbach's α = .78) (Kılıç, 1996). Each of the 12 items of GHQ-12 was rated based on a 4-point Likert scale (0 = no, not at all, 3 = much more than usual) and summed up for the scoring. Higher scores indicate higher psychological distress and worse mental well-being. A sample item was "Have you recently been able to enjoy your normal day-to-day activities?". In this study, a robust internal consistency value was gathered (Cronbach's α = .88).

Work engagement

Work engagement was measured with Utrecht Work Engagement Scale in line with the work engagement model developed by Schaufeli et al. (2006). In the scale, work engagement covers three sub-dimensions as vigor, dedication, and self-absorption and each dimension yielded sufficient internal consistency scores (Cronbach's α = .80, .91, and .75, respectively). The Turkish version of the scale is proved to be valid and reliable by Eryılmaz and Doğan with sufficient internal consistency on the whole scale (Cronbach's α = .91) (Eryılmaz and Doğan, 2012). The scale was used to evaluate the characteristics of work in terms of vigor (e.g., "At my work, I feel bursting with energy", dedication (e.g., "I find the work that I do full of meaning and purpose"), and self-absorption (e.g., "When I am working, I forget everything else around me") dimensions. 17 items were rated based on a 7-point Likert scale (0 = never, 6 = every day) which constitutes the total work engagement score when summed up. Higher scores indicate higher work engagement. In this study, a robust internal consistency value was gathered (Cronbach's α = .84).

3.3. Procedure

The survey included demographic and non-scale questions related to home-based work setting at the beginning and the questions of the scales of mental well-being and work engagement, job strain, and sleep quality followed. At the beginning of the survey, the research aim was explained and contact details were given. Before each scale, participants were instructed to answer the questions in the context of home-based work setting during the pandemic. The questionnaire was piloted with 31 software professionals to confirm the understandability of the instructions and the questions which were not in the used scales. After several iterations, some questions and instructions were restated to enhance the understandability. The original questions of the scales were applied "as it is" to address validity and reliability concerns. Participants had no timing restrictions but completing the survey lasted approximately 15 min. The survey was anonymous and no personal data was collected. After the gathered feedback, improvements were finalized and participants were asked to answer the survey using the link to the Google form. After the collection of data, it was sorted, and invalid responses were removed.

3.4. Research design

The present research is designed to understand the effects of job strain and resource-related variables as sleep quality, work-life balance, having exercise, and having decision latitude on mental well-being and work engagement of software professionals during pandemic home-based working. As aforementioned before, the former group of variables is conceptualized as replenishers of depleted psychological resources during home-based working in pandemic conditions.

3.5. Data analytic strategy

Statistical analyses were conducted with IBM SPSS Statistics 25.0. The missing data analysis was conducted. The missing data were not at random and consistently observed in the sleep quality (PUKI) scale that 5 participants (1.6%) skipped the related items and were pair-wisely excluded from the analysis. To control for artificial effects and gather less noisy data, outlier analyses were performed and the outlier cases were removed. After outlier correction, the number of participants included in the further analyses remained 309. The prerequisite of normal distribution was checked from the skewness and kurtosis values for each continuous variable. Data for job strain and sleep quality showed higher kurtosis values than the acceptable range and were log-transformed to achieve normality. After transformation, data were proved to be normally distributed that all of the variables subjected to the analysis showed acceptable skewness and kurtosis values (range from −2 to +2) (George and Mallery, 2010). For the mental well-being, as higher scores indicate higher psychological distress and worse mental well-being, the responses were recorded to transform the higher values into lower corresponding values so that the higher mental well-being score corresponds to lower distress levels which is shown in Table 1. Dummy variables were created for work-life balance and exercise habits.

4. Results

4.1. Bivariate correlations among variables

Pearson product correlations were calculated among the variables of interest. All the psychological resource-related variables namely sleep quality, work-life balance, having exercise and having decision latitude; and job strain (in the reverse direction) significantly associated with well-being, the first dependent variable. Thus, the relations were in the expected direction. Job strain

was expected to negatively predict the well-being scores and the resource-related variables were entered into the analysis to observe whether they counteract this negative relationship and act as a buffer. In a similar vein, for the work engagement, as the second dependent variable, only the sleep quality and decision latitude were associated significantly. In the rationale of the hierarchical regression modeling described below, sleep quality was the most powerful resource-related variable for the mental well-being and decision latitude for the work engagement. The relation between work engagement and mental well-being was positively significant. All the significant relations were in the expected direction as seen in Tables 1 and 2.

4.2. Hierarchical regression modeling

To estimate the effects of several predictors on mental well-being and work engagement scores as dependent variables, two hierarchical multiple regression analysis were conducted. Variables were grouped based on the order of entrance to the analysis within the logic of hierarchical multiple regression to detect gradual improvement of the models. In the first block, only the demographic variables that are significantly associated with outcome variables are included to preserve power (Becker, 2005). Marital status and job status (position: personnel, expert, senior expert, manager, and administrator) were entered as the significant ones. In the second block, job strain was entered. The third block was created to test the relative specific contribution of the variables which were conceptualized as replenishers of depleted psychological resources. Sleep quality, work-life balance, having exercise and having decision latitude in one's job were entered with forward command.

In the first model with mental well-being scores as the outcome variable, demographic variables explained 5% of the variance. Positions of being expert, senior expert, and manager in one's job were significant predictors. In the second step, job strain increased the ability to predict well-being up to 12% (ΔR2 = .069, p = .000). Sleep quality explained 17% variance by itself and the total ultimate variance increased up to %35 with work-life balance (ΔR2 = .040, p = .000), exercise (ΔR2 = .014, p = .013) and decision latitude (ΔR2 = .008, p = .047). The third block accounted for 22% of the variance with sleep quality, work-life balance, and exercise. After the third block entered, the variance explained by job strain was no longer significant (β = .10, p = .067) and all the other variables remained significant.

In the second model with work engagement scores as the outcome variable, the same procedure was applied in the same order. Job-status was the only significant variable and accounted for 2% of the variance. Job strain increased the predictive power up to 8% (ΔR2 = .055, p = .000). Decision latitude explained 7% of the variance (ΔR2 = .069, p = .000) by itself and the remained significant predictor was sleep quality with contributing to only 1% change of variance. The total ultimate variance was 15% and the third block explained 8% of the variance on work engagement. After the third block entered, the variance explained by job strain was no longer significant (β = −.04, p = .053) and decision latitude and sleep quality remained significant. Cumulative significant values of the regression models at the time they entered are shown in Tables 2 and 3 both for mental well-being and work engagement.

Table 1
Correlations among variables.

	1	2	3	4	5	6	7
1. Mental well-being	–						
2. Engagement	.34**	–					
3. Job strain	−.25**	−.24**	–				
4. Sleep quality	−.45**	−.17**	−.12*	–			
5. Decision latitude	.24**	.38**	−.56*	−.14**	–		
6. Work-life balance	.33**	.10	−.15**	−.26**	.13*	–	
7. Exercise	.18**	.03	−.00	−.06	−.02	.05	–

*$p < .05$, **$p < .01$. Mental well-being scores were recoded so that higher scores indicate greater well-being.

Table 2
Hierarchical regression analyses predicting work engagement.

Variables	R	R^2	Adjusted R^2	β	t	F change	F
Step 1							
Job position	.20	.04	.02	–	7.72	2.61	80.09*
Step 2							
Job strain	.31	.09	.07	−.23	6.58**	17.82	47.60**
Step 3							
Decision latitude	.40	.16	.14	.33	3.10**	24.23	37.97**
Sleep quality	.42	.17	.15	−.11	3.40*	4.69	32.78**

*$p < .05$, **$p < .01$.

Table 3
Hierarchical regression analyses predicting mental well-being.

Variables	R	R^2	Adjusted R^2	β	t	F change	F
Step 1							
Job position	.27	.07	.05	–		3.08	3.08**
Expert				−.31	−2.38*		
Senior expert				−.33	−2.75*		
Manager				−.27	−2.49***		
Step 2							
Job strain	.38	.14	.12	.26	4.85**	23.57	5.57**
Step 3							
Sleep quality	.56	.31	.29	.36	8.59**	73.92	13.64**
Work-life balance	.59	.35	.33	−.20	−4.26**	18.21	14.79**
Exercise	.60	.37	.34	−.12	−2.51*	6.30	14.33**
Decision latitude	.61	.38	.35	−.12	−1.99*	3.97	13.67**

*$p < .05$, **$p < .01$.

5. Discussion

The current study has intended to explore predictors of mental well-being and work engagement of software professionals during the forced home-based working period in pandemic through hierarchical regression analysis. The independent variables considered in the study are participants' job strain and resource-related protective factors (i.e. sleep quality, exercise, decision latitude, and work-life balance). A positive association of resource-related protective factors and a negative association of job strain with the dependent variables are hypothesized. The results obtained in this study are discussed by examining the limited number of COVID-19 studies in the software engineering domain, and by referring to the studies conducted in other domains on the focused constructs as well.

The first finding reveals the positive association between software practitioners' mental well-being and work engagement. A similar relationship is reported in the pre-pandemic period (Graziotin et al., 2018). Hence, organizations implementing interventions for supporting mental well-being of their employees would enable their dedication to work tasks that would result in better work outcomes.

Results suggest that all of the personal resource-related variables despite the negative effect of job strain predict mental well-being. After sleep quality, exercise, decision latitude, and work-life balance entered the model, job strain no longer predicted mental well-being. In this relationship, sleep quality being the most influential factor can explain 17% variance in mental well-being alone. Additionally, work engagement is predicted by job strain, sleep quality, and decision latitude. Exercise and work-life balance did not contribute significantly. After sleep quality

and decision latitude entered the model, job strain no longer predicted work engagement. Decision latitude is the most powerful factor, that explained 7% variance.

One of the findings has shown that job strain predicts mental well-being and work engagement negatively, confirming the hypotheses H1 and H2. This result is consistent with the previous findings. It was shown that adverse effects of stress on both physical and mental conditions such as high-systolic blood pressure, anxiety, and burnout may develop after long periods of exposure to job strain (Sorensen et al., 1985; Iacovides et al., 2003; Blazer et al., 1987; Anthony-McMann et al., 2017). Even though the flexible working arrangements were found to have the potential to improve work engagement by providing more autonomy (Bakker and Bal, 2010), and hence resulting in better performance (Conradie and de Klerk, 2019), with the strict COVID-19 constraints, the psychosocial environment might have been affected negatively. This may have a consequential effect on work engagement in the home-based work setting.

The results of this study suggest that despite the negative effect of job strain in home-based working, sleep quality is the most significant predictor supporting hypothesis H3. This is in line with prior research that mentions the positive effect of high sleep quality on well-being (Barber et al., 2009; Beebe and Gozal, 2002). Additionally, parallel to the findings of the current study, sleep quality was found to be connected with the general well-being of software professionals during the COVID-19 period (Russo et al., 2021b). Russo et al. have used two questions to explore the effect of sleep quality on well-being during the pandemic (Russo et al., 2021b). The current study has extended the findings of Russo et al. by applying a validated sleep quality scale (PSQI) with 19 questions and 7 components (Russo et al., 2021b).

Adverse effects of low sleep quality on mental health and well-being are mentioned by several studies (Kahn et al., 2013; Vandekerckhove and Cluydts, 2010). As pandemic forced everyone to change their normal living and working conditions and adapt to the new life challenges including social distancing, quarantines, lockdown, working from home might have created risks of poor mental well-being and stress, and increased anxiety. Several non-pharmacological interventions such as mindfulness-based practices (Butz and Stahlberg, 2018; Åkerstedt et al., 2002), meditation practices (Brand et al., 2012; Gross others, 2011), calming music (Mornhinweg and Voignier, 1995; Morin et al., 2006) were shown to support sleep problems. Accordingly, the effect of these techniques could be researched for software professionals' better sleep experience.

Furthermore, the positive effect of exercise on sleep disorder was proven through various studies (Hartescu et al., 2015; Reid et al., 2010; Youngstedt, 2005). Exercising is considered to affect not only sleep quality but also well-being and mental health (Buman et al., 2011; Singh et al., 1997; Montgomery and Dennis, 2002). Likewise, the protective effect of exercising on sleep quality and hence on software practitioners' mental well-being and work engagement entails further research. Furthermore, several studies also mention the relationship between sleep disorders and social media use in bed before sleep as it may cause cognitive stimulation diminishing ability to mentally shut down (Levenson et al., 2016) as blue light produced by electronic devices disturbs falling into sleep (Cajochen others, 2011). Further research may be conducted to explore the effect of social media use on software professionals' sleep quality.

Previous research on the effect of sleep on work engagement has found mixed results. Disrupted sleep was found to result in reduced self-control (Christian and Ellis, 2011), diminished productivity (Wagner et al., 2012) and positive effect on work engagement (Diestel et al., 2015). Lanaj et al. found no relationship between sleep duration and work engagement but they found that the relationship between low sleep duration and ego depletion resulted in reduced work engagement (Lanaj et al., 2014). Diestel et al. found that sleep quality affects work engagement positively (Diestel et al., 2015). One of the results of the current study states that despite the negative effect of job strain in home-based working, sleep quality explained 1% of the variability, significant but small effect size, in the software professionals' work engagement positively, confirming hypothesis H4.

Additionally, one of the results of the regression analysis suggests that decision latitude predicts mental well-being and work engagement which satisfies hypotheses H5 and H6. Decision latitude predicts 7% of the variability in work engagement, whereas only 1% of the variability in mental well-being. This outcome is parallel to the study of Russo et al. where the need for autonomy was found to be connected with general well-being measured by questions as a part of the psychological needs scale (Russo et al., 2021b). In the context of pandemic, supporting software practitioners managing their work flexibly may help to satisfy their expectations for autonomy (Russo et al., 2021b). Decision latitude is a factor describing control on the job, explicitly, enables authority in task-relevant decisions (Westman, 1992). Resources in the job environments were shown to predict work engagement and well-being through increased autonomy and job satisfaction (Bakker and Demerouti, 2008). Particularly software work requires autonomy, and longing for constant learning compared to traditional occupations (Hyman et al., 2003a; Arendt and Brettel, 2010; Brian Joo et al., 2016), supportively the results suggest that decision latitude is a predictive factor for both mental well-being and work engagement during the pandemic period.

Another finding of this study shows that work-life balance predicts mental well-being positively hence hypothesis H7 is confirmed. Accordingly, several studies have explored work and family life conflicts (Allen et al., 2015) and mentioned the adverse effects of workplace and family changes on work-family life balance (Kossek, 2016). Moreover, some workers may have difficulty in adapting to home-based working as it encompasses less social interaction and managing private and work life effectively (IOSH, 2014). Supportively, the participants' easiness in getting used to the new home-based working routine and ability to separate work–private life are related to mental well-being (Nitzsche et al., 2014; Evans et al., 2013). Consequently, as work-family conflict results in exhaustion of limited resources and leads to deteriorated self-control (Baumeister et al., 1998), it would affect mental well-being and work engagement.

However, another result of the regression analysis states that there is no association between work-life balance and work engagement. Hence, hypothesis H8 is rejected. It was expected that as work-family imbalance results in exhaustion of resources, individuals may withdraw from work responsibilities that results in low work engagement based on COR theory. It was surprising to observe that the current analysis has shown that there is no association between work-life balance and work engagement. This outcome is not consistent with earlier research that showed remarkable relationships between those variables. The prior studies have shown that work engagement and work-life balance constructs are related (Ilies et al., 2017; Vîrgă et al., 2015) and linked (Parkes and Langford, 2008). One possible explanation that illuminated the contradiction between the present and earlier findings might be the types or level of work-family conflict that exist in the home-based work setting. In other words, it was not the existence but the nature of the work-family conflict that explained its relationship with work engagement that deserves further investigation. Moreover, people practice diverse roles through life stages, and as a result, the degree of work-life balance changes continuously throughout their lives (Kalliath and Brough, 2008). Hence, their resource allocation strategies in

coping with difficulties such as balancing work and life demands may change as well which may explain the finding of the current study that deserves further exploration.

Furthermore, the analysis revealed that exercise predicts mental well-being positively which confirms hypothesis H9. This result is consistent with earlier findings, mentioning the positive benefits of exercise both on physical and as a consequence on the psychological health of people at any age (Fernandes et al., 2017; Chieffi et al., 2017; Pereira et al., 2007; Winter others, 2007). The connection between biological and psychological mechanisms related to exercise is a well-known fact which was shown to improve the well-being of individuals (Penedo and Dahn, 2005). Prior research has evidence on the motivating characteristics of including game elements in physical exercising (Olson et al., 2007; Cavalcanti, 2020). Hence, future studies may explore the effects of exergaming on software professional's mental well-being during home-based working individually or in a group.

In the literature, there are contradicting findings for the relationship between exercise and work engagement. While some studies suggested a positive association between exercise and work engagement, no effect was found between health-promoting interventions and work engagement as well (Oude Hengel et al., 2012). The regression model resulted in no predictive power of exercise on work engagement hence hypothesis H10 is rejected. This outcome could be originated from the measurement method used for exercise as it is measured only by two questions. Further research could investigate this association with validated scales more deeply by considering software professionals.

Practical implications

Pandemic has forced software companies to shift to remote work arrangement suddenly with no prior preparation. As software companies and individuals were caught unprepared for the remote work, they had difficulties in managing the new work arrangement which has caused challenges such as increased number of exhaustive meetings, fewer breaks, and working more hours than usual (JRebel, 2020; Smite et al., 2021).

As known, managing employees in a remote work setting has several challenges (Buffer, 2020) which have been more problematic as family members needed to coexist during the workday in pandemic (Anselmo Da Mota et al., 2021). In the specific context of the COVID-19 crisis, software professionals and companies could explore ways to adapt to the new home-based working and living arrangements by constant monitoring, communication, and assistance for enhancements in job strain, sleep quality, decision latitude, work-life balance, and exercising. Software professionals' mental well-being and work engagement contribute to project performance and should be closely observed by managers periodically during crisis situations.

One of the results has shown the predictive power of decision latitude on mental well-being and work engagement. Accordingly, management could provide flexibility for remote workers in organizing their activities (Wang et al., 2016) to promote their need for autonomy and offer necessary opportunities for skill development for better work outcomes (Gagné et al., 2000; Baard et al., 2004) which is also mentioned in the study conducted with software professionals during pandemic (Anselmo Da Mota et al., 2021). Consequently, supervisors in software companies would give engineers enough space and opportunities where they can perform their tasks self-directedly which would promote personal development to enhance software practitioners' engagement to work by considering individual dissimilarities. This is in parallel with the results of the study of Russo et al. (2021b) where autonomy was found to affect well-being where individual differences in need for autonomy were highlighted. Accordingly, management would provide various degrees of autonomy to engineers by considering their personal need or preference.

As the deadlines are demanding in software projects, it can be challenging for a software professional to turn off the computer at the end of the workday and switch to the private life in a home-based working arrangement. The positive impact of work-life balance on software professional's mental well-being is revealed in the findings as well. During forced remote work, imbalance in work and private life is mentioned as one of the challenges (Anselmo Da Mota et al., 2021). Because of insufficient guidance, software professionals may be drawn to working more than usual periods that may result in increased work pressure, stress, and eventually psychological diseases, such as burnouts in home-based work. Accordingly, during pandemic home-based work setting, software practitioners were reported to work more hours daily than their usual work periods (Smite et al., 2021). Consequently, companies could support their employees on time management for work-life balance through practical training and suggest work–private life separation strategies (Baltes et al., 2009) that would enable software professionals to put healthy boundaries between their private and professional lives. Policies such as constraints on work-related usage of communication channels, such as emails, mobile phones, can be agreed upon and supported by managers (Baltes et al., 2009). This could give the sense of being cared for by the companies and hence promote mental well-being. Future research could explore the effect of such policies for building healthy boundaries for work–private life for promoting the mental well-being of software workers.

This study found that sleep quality is a factor predicting mental well-being and work engagement which is important from a managerial perspective. Software professionals usually work uneven hours (Rodriguez et al., 2018) with a high level of focus and attention for their tasks which may diminish their resources resulting in refraining from work activities. Accordingly, management of companies could raise awareness of software workers' sleep quality by suggesting periodic checks. In addition, they could provide support to software practitioners who are experiencing sleep quality problems and may recommend coping mechanisms for the solution such as mindfulness practices.

Based on the finding that points out the negative effect of job strain on the dependent variables, the influence of factors such as hobbies, or virtual socialization events outside work that may replenish personal resources for software workers could be investigated further to mitigate the negative effect of job strain during pandemic home-based work. Managers or supervisors could be in constant communication with software practitioners and support their periodic breaks as suggested by Nolan et al. (2021) as well.

Limitations and future work

There are various limitations to this study that can provide new topics for further research. First, the research was conducted as a cross-sectional study. In cross-sectional studies, causality cannot be inferred from the results, as the temporal sequence cannot be ensured (Eisenstein, 2021). Still, there is evidence that a cross-sectional survey strategy could be considered feasible when compared to the longitudinal survey (Rindfleisch et al., 2008). On the other hand, in crises temporal effect of the unfamiliar situation might have an impact on the research outcomes as participants' responses to the crisis may change in time. Future research may explore the relationship between the focused variables by collecting data at different times of the crisis event through a longitudinal study.

This study has adopted a non-random sampling which is one of the common cases in empirical studies in software engineering (Amir and Ralph, 2018). Even this sampling method ceases the possibility to generalize the results to all software developers, we believe that having employed a sound research method and conducted comprehensive analyses, the findings of this study

are valuable to the community as it provides substantial insights on mental well-being and work engagement of software practitioners during a pandemic.

The scales used in the study were applied "as it is" to confirm the validity and reliability. If the original scales used here are to be adapted to the software engineering field, validity and reliability studies could be performed as future research. Future research may also explore the impact of factors related to software development processes on the mental well-being and work engagement constructs by including survey questions related to software processes.

In the survey, single questions were used to collect data for work-life balance and exercise variables and this may entail further exploration to have in-depth analysis regarding these specific variables. Additionally, the results are based on the respondents' self-reports which limits the study's validity.

The findings of the study conducted in Turkey cannot be generalizable to software professionals all around the world. Hence, this study can be replicated in other countries. Additionally, testing the results of the current study concerning the specific occupational groups within the software domain such as managers or junior workers may be valuable. Research in the future may also look into the individual differences (e.g. personality) and also country-based variances in terms of pandemic measures and work culture in crisis conditions. This would lead to better identifying the factors associated with software professionals' mental well-being and work engagement.

6. Conclusion

As strict measures were taken to slow down the spread of the virus during the COVID-19 pandemic, software professionals have been forced to work from home which has introduced many challenges in home-based work setting on mental well-being and work engagement. Consequently, this study has an intention to explore the relationship between job strain, resource-related factors (sleep quality, work-life balance, exercise, and decision latitude), and mental well-being and work engagement of software professionals during home-based working arrangement in the COVID-19 pandemic by leveraging the Conservation of Resources (COR) and Broaden-and-build theories as the primary theoretical base.

The findings suggest that sleep quality, exercise, decision latitude, and work-life balance, and job strain predict mental well-being. Similarly, sleep quality, decision latitude, and job strain predict work engagement. Hence, constant monitoring and providing enhancements for these factors under crisis conditions may provide substantial benefits in terms of mental well-being and work engagement of software practitioners.

As new waves of the COVID-19 pandemic and similar pandemic periods are foreseen in the future, and since the home-based work arrangement has the potential to become an alternative work setting in many organizations, it becomes critical to act proactively in order to handle the negative consequences of home-based work setting on software developers and companies. Specifically, the findings of this study suggest that job strain and resource-related factors deserve considerable attention to mitigate the undesirable effects on the software practitioners' mental well-being and work engagement during home-based work arrangement.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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