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Algorithmic management, wellbeing and platform work: understanding the psychosocial risks and experiences of food couriers in Finland

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ABSTRACT

Digitalisation has made algorithmic management a defining feature of platform work. This study explores the psychosocial stresses and risks associated with different algorithmic management practices and analyses the applicability of Job Demand-Control-Support model in examining food delivery platform work. Our findings draw from 30 semi-structured interviews with platform food couriers in Finland. We applied Job Demand-Control-Support framework as the analysis matrix to inductive qualitative content analysis and compared the algorithmic management practices of the two dominant food delivery platforms in Finland. This study established that algorithmic management had direct and indirect intertwined negative psychosocial influence on couriers. These impacts were varied and were related to how algorithmic management was employed by the platforms. We also found that algorithmic management can increase work demands, decrease couriers' control over their work, and limit workplace support. The study demonstrated that Job Demand-Control-Support model is suitable for analysing stress related to algorithmic management and platform work. This supports its application in future quantitative analyses. Our study deepens the understanding of psychosocial issues associated with the emerging trend of algorithmic management in workplaces, which is a fundamental dimension of the future of work. It highlights the need for regulatory measures relevant in ensuring healthy work environments.

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Psychosocial risks; platform work; algorithmic management; work stress; gig work; occupational health and wellbeing

Introduction and background

Digitalisation and advancements of technologies have given rise to algorithmic management [AM], which is the remote management of workforces through (semi)automated algorithmic practices (Mateescu and Nguyen 2019; Möhlmann et al. 2021). It can transform workplaces by changing the design, organisation and management of work (Baiocco et al. 2022; Kinowska and Sienkiewicz 2023). Unlike conventional work settings where managers and supervisors directly monitor, manage, control and interact with workers,

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the use of AM in these roles limits or eliminates human involvement, which can impair health and well-being of workers.

This new form of management emerged from platform work (Baiocco et al. 2022; Mateescu and Nguyen 2019; Wood 2021) and has been the central distinguishing feature of platform work from traditional forms of work (Benlian et al. 2022; Duggan et al. 2020). Although AM has just recently begun expanding across conventional work sectors (Kinowska and Sienkiewicz 2023; Mateescu and Nguyen 2019; Rani et al. 2024), it is pervasively employed in platform work (Baiocco et al. 2022; Mateescu and Nguyen 2019; Wood 2021). Platform work in our study, refers to the 'matching of demand and supply of paid work, through an online platform using an algorithm' (Eurofound 2018).

It is expected that AM will become a defining feature of the future of work. This necessitates research to understand its impacts on the health and wellbeing of workers, which is crucial in the understanding of, and preventing, its health implications from becoming detrimental. Given that platform work is the origin of AM, it is imperative that the foundation of this understanding is built from the experiences and challenges observed in the AM practices of platform work. This is essential to ensuring safer and healthier digital management of workers.

Algorithmic management in platform work and worker wellbeing

Platform work critically depends on algorithmic systems for its operations (Benlian et al. 2022; Duggan et al. 2020; Jarrahi et al. 2021). Platform companies employ algorithms to operate as the main mechanism in the coordination of its activities, and have primary duties to supervise, make and implement work decisions with minimal or no human involvement (Duggan et al. 2020; Kellogg et al. 2020; Möhlmann et al. 2021). Beyond surveillance of workers, algorithms are designed in such a way that they can assess and evaluate workers' productivity and performance; reward, discipline, recruit and terminate workers; allocate work and direct workers on their work (Baiocco et al. 2022; Howard 2022; Kellogg et al. 2020; Möhlmann et al. 2021; Wood 2021). Although AM may limit human related errors and enhance workers' occupational health and safety, they can also present health and wellbeing challenges among workers (Howard 2022; Jarrahi et al. 2021; Kellogg et al. 2020; Kinowska and Sienkiewicz 2023), generating psychosocial challenges for workers in the context of work demands, control and support.

Extensive literature on platform work have explored the sociotechnical features of AM in platform work and have shown that AM can substantially generate control over workforce in different ways which may erode workers' autonomy (see Griesbach et al. 2019; Kellogg et al. 2020; Veen et al. 2020). Explicatively, algorithms manage the workforce through pre-set rules which workers are required to follow, they allocate work, monitor and evaluate workers' performances according to the predefined criteria (Baiocco et al. 2022; Kellogg et al. 2020; Möhlmann et al. 2021). These leave workers with limited or no room to make independent decisions or exercise discretion and can negatively impact their mental wellbeing. Although platform workers theoretically have the autonomy to choose their tasks, when and how they work, algorithmic surveillance, ratings and penalties often undermine this freedom, leading to perceptions of unfair treatment (Baiocco et al. 2022; Duggan et al. 2020; Jesnes 2023; Kellogg et al. 2020). Additionally, nudging by algorithms is linked to worker control in platform work as a mechanism to

influence workers' behaviours (Kellogg et al. 2020; Möhlmann et al. 2021). While it may enhance workers' autonomy to some extent (Wang and Lee 2022), workers may feel pressurised to conform to the nudges which can limit their decision discretion and can be stressful and frustrating (Gregory 2021; Griesbach et al. 2019; Kellogg et al. 2020; Parent-Rocheleau and Parker 2022). Further, AM in platform work has been strongly associated with lack of transparency on the functioning of algorithms as platform workers tend to be unaware of the criteria and processes used by algorithms in evaluating their performances, the reliability and accuracy of the evaluation systems (Baiocco et al. 2022; Gregory 2021; Kellogg et al. 2020; Mateescu and Nguyen 2019). This creates information asymmetries between platform workers and the platforms (Baiocco et al. 2022; Kellogg et al. 2020; Mateescu and Nguyen 2019) and can undermine workers' autonomy and can also lead to anxiety, frustrations and uncertainty (Gregory 2021; Parent-Rocheleau and Parker 2022).

In the context of work demands, a considerable number of studies indicate that AM in platform work can significantly increase demands of work by increasing workload and work intensity for workers. For instance, studies have shown how AM can push platform workers to work at high pace due to demands to meet algorithmic expectations and metrics (Baiocco et al. 2022; Wood 2021). Workers tend to be subjected to time pressure which can generate constant stress among them (Baiocco et al. 2022) and expose them to physical risks (for example, Christie and Ward 2019; Gregory 2021). Additionally, when workers depend on algorithmic work-on-demand, they experience intense pressure to shift to the next task (see Christie and Ward 2019). Also, this often results in longer working hours and in unsocial, irregular hours, contributing to high workload which can generate physical and psychological exhaustion thereby putting workers at a risk of burnout (Baiocco et al. 2022; Christie and Ward 2019; Parent-Rocheleau and Parker 2022).

In relation to workplace support, empirical literature have highlighted how working under AM can change workplace relationships by enhancing spatial dispersion of work and limiting workplace interactions (Benlian et al. 2022; Jarrahi et al. 2021; Möhlmann et al. 2021), which may result in isolation and alienation among workers (Benlian et al. 2022; Kellogg et al. 2020). Working under AM metrics sometimes place platform workers in a competitive work environment which may also limit their interactions and support to each other (Baiocco et al. 2022; Benlian et al. 2022). Additionally, as algorithms takes over management roles, platform workers are usually unlikely to meet with their platform 'employers' (Duggan et al. 2020) neither do they have substantial interactions with their digital manager (Howard 2022), which can considerably limit organisational support for them. Also, owing to the virtual interaction, sometimes the workplace support channels are obstructed or replaced by algorithmic processes (Duggan et al. 2020). It is typical that when workers reach out to platforms for support, they encounter automated algorithm-driven responses that do not always address their concerns which can also generate feelings of isolation and disregarded (Duggan et al. 2020; Kellogg et al. 2020). In light of these, it is likely that platform workers encounter low workplace support which may enhance their work-related stress.

The limited autonomy and workplace support due to AM can create imbalance of power between workers and platforms (Duggan et al. 2020; Griesbach et al. 2019; Jarrahi et al. 2021). While this may engender inequalities and unfairness (Duggan et al. 2020; Parent-Rocheleau and Parker 2022), workers can also develop feelings of powerlessness,

which may be heightened by their inability to discuss or challenge the (semi)automated decisions of AM (Kellogg et al. 2020; Mateescu and Nguyen 2019; Wang and Lee 2022). Increased job demands, with limited workplace autonomy and support among workers experienced on AM in platform work can subject workers to psychosocial risks such as musculoskeletal issues, depression, anxiety, work-related stress, frustrations, precarity and poor work-life balance (Baiocco et al. 2022; Lang et al. 2023; Wang and Lee 2022; Zhang et al. 2023). Although AM can enhance organisational efficiency (Benlian et al. 2022; Jarrahi et al. 2021), it has the potential to worsen the psychosocial risks or generate new ones (Berastegui 2021). Psychosocial risks arise from stressful work aspects which are related to the design and management of work, as well as its social and organisational contexts, and may result in negative psychological, social or physical outcomes (Forastieri 2016).

Research on platform work suggests that AM practices can vary significantly across platforms. Griesbach et al. (2019) and Veen et al. (2020) illustrates this through their study of algorithmic control in different food delivery platforms [FDPs] in the US and Australia respectively. Country-specific regulatory contexts can also influence AM practices (Koivusalo et al. 2024) which imply that same platform organisation may have varied AM practices across countries. These variations can result in heterogeneous psychosocial experiences among platform workers, indicating that psychosocial risks and stress across platforms and AM practices should not be generalised but rather approached cautiously. Analysing individual platforms provides nuanced insights which can inform effective regulatory measures for specific psychosocial risks and challenges unique to each platform's work environment.

Essentially, attention should be drawn to the fact that many previous studies that have highlighted the psychosocial risks of AM in platform work are either reviews (for example, Berastegui 2021) or they do not explicitly examine these risks for food delivery platform [FDP] work. Only few studies have examined the occupational health, safety and well-being relative to AM among platform workers working in food delivery services (Vignola et al. 2023). This leaves a significant research gap in understanding the psychosocial risks and implications specific to AM in FDP work.

The present study

In light of the above, in this study we used an example of FDP work in Finland to identify and understand the psychosocial stress and risks associated with AM in relation to work demands, control and support. As previously mentioned, these three aspects of work are the key sources of psychosocial implications of platform work and are significantly linked to FDP work – hence, we chose to base our analysis on them. FDP work being the most visible and widespread type of platform work in Finland (Mattila 2020), it was the ideal example for examining the psychosocial impacts of AM. Further, the scarcity of empirical research on health and wellbeing related to FDP work in Finland underscores the need for further investigation.

In Finland, FDP workers operate legally as independent contractors. Theoretically, they are expected to be able to manage their job demands by managing their workloads without pressure, have high degree of job control which includes workplace autonomy and flexibility, and ability to access workplace support that is relevant to their work.

However, AM can control their work environment and may subject them to increased job demands, limited control over their work and low workplace support. Consequently, they may be exposed to psychosocial risks and may experience higher levels of job stress which may impair their psychosocial wellbeing.

We analysed and compared the AM practices of the two main FDPs in Finland (we refer them as Platform X and Platform Y), to understand how, and the extent in which, different AM practices can influence the psychosocial health and wellbeing of platform food couriers. To enhance our understanding of the psychosocial aspects of these elements, we employed the Job Demands-Control-Support [JDCS] theoretical framework (Karasek and Theorell 1990) to the qualitative analysis to enable us to examine these elements closely. Given that other occupational wellbeing models like Job Demands-Resources (Demerouti et al. 2001) and Effort-Reward Imbalance (Siegrist 1996) do not pay close attention to these elements, the JDCS was thus the preferable theoretical framework for our study.

Although JDCS has been the bedrock for many studies investigating different kinds of work environments (Fila 2016), it was not founded for jobs which are entirely managed by algorithms. Thus, we wanted to analyse the extent to which it can be theorised in the study of platform work. To our knowledge, it has not been yet employed to the study of platform work at the time of writing this article. Additionally, while it is commonly associated with quantitative studies, its use in qualitative studies is expanding (for example Fernemark et al. 2020). Thus, its application in this qualitative study provides significant insights for future quantitative analyses.

Moreover, on-location platform workers are often a 'hard-to-survey' population (Tourangeau 2014). The main survey route to platform workers is through the platform provider, which can create a potential bias even if the survey was not under direct oversight of the platform provider. Thus, interviews can provide both crucial value for further quantitative analysis and a richer and more independent source of data for analysis. Furthermore, platform work being a new phenomenon in Finland, qualitative methodologies were preferable for our study for the potential to provide in-depth insights from FDP workers as 'evolving phenomenon cannot be easily measured' with existing knowledge (Creswell and Poth 2016, 45).

Our study was guided by the questions:

(1) How does management by algorithms influence the psychosocial work demands, control, and support among food delivery platform workers in Finland?
(2) What kind of organisational management takes shape in platform economy in light of job demand-control-support?

Job demand-control-support framework

JDCS work model (Karasek and Theorell 1990) is an extension of Job Demand-Control model (Karasek 1979) which highlights the impacts of work factors on stress and the general occupational health and wellbeing of workers. It categorises jobs into four types: high strain, active, passive and low strain jobs. Karasek (1979) regarded high strain jobs as those where workers have high demands and little control over their work. He stipulated that these kinds of jobs are most likely to

Table 1. The concepts of the job demands-control-support theoretical framework relevant to our study (Karasek 1979; Karasek and Theorell 1990).

Aspect	Description	Psychosocial influence
Iso strain jobs	Jobs where workers experience high work demands, low control over work and low workplace support	Can generate substantial stress and worse psychosocial outcomes
Job demands	Aspects of work which require physical and, or psychological strain to accomplish the job.	High demands may generate stress, fatigue and other negative psychosocial outcomes.
Job control	Degree of workers' autonomy and discretion over tasks and work-related processes.	Low or lack of control over work may generate or worsen psychological stress. Having high control can reduce stress.
Job social support	The overall level of helpful support and social interactions available from both supervisors and co-workers.	High workplace support can mitigate or buffer the overall psychosocial implications, improving workers' wellbeing.

generate high stress and can deteriorate workers' wellbeing with workers experiencing burn out. Further, jobs where workers face high work demands but have high control over their work, he classified as active jobs. He argued that the high control can moderate the high demands, thus enabling workers to effectively manage the demands, leading to greater job satisfaction and productivity. Subsequently, he categorised jobs where workers have low work demands and low control over work as passive jobs. In these jobs, he posited that workers tend to experience a little stress due to boredom and lack of control. Lastly, Karasek (1979) classified jobs with high demands and low levels of control as low strain jobs stating that workers tend to benefit from the high levels of autonomy without pressure of high demands.

Later, Karasek acknowledged the importance of workplace social support as a predictor of wellbeing and stress and extended the model to job demand-control-support [JDCS] (Karasek and Theorell 1990). In the JDCS model, Karasek and Theorell (1990), argued that workplace support and meaningful interactions from co-workers and supervisors is critical in buffering the effects of job demands and control. When the work environment is supportive, the level of work stress and negative psychosocial outcomes can be moderated thus enhancing workers wellbeing. Notably in the JDCS model, Karasek and Theorell (1990) introduced the term iso-strain jobs to describe high strain jobs where workers experience additional stress and psychosocial strains due to social isolation or lack of workplace support.

FDP work is linked with significant psychosocial stress due to high job demands, limited workplace autonomy among couriers and limited workplace support. These factors clearly demonstrate the iso-strain characteristics of the job. Therefore, the JDCS model by Karasek and Theorell (1990) highly suitable for analysing this phenomenon. Table 1 illustrates the concepts of the JDCS relevant in our study.

Materials and methods

We used qualitative research approaches to provide an in-depth understanding of the meanings of participants' perceptions and experiences of psychosocial stress and risks in relation to demands-control-support of AM in FDP work. The methodology of the study is described below.

Data collection

Our study draws from a total of 30 semi-structured interviews of FDP workers in the cities of Helsinki and Tampere, Finland. Twenty interviews were collected from couriers in Helsinki between July and August 2020 and further 10 interviews were collected from couriers in Tampere between October and November 2021. The study was independent from platform corporations. Interviews with couriers in Helsinki were done by the first author and another junior researcher, while data from couriers in Tampere were collected by the first author. Semi-structured interviews enhance comprehensive discussions which allows deep exploration of participants' experiences, perceptions and feelings (Creswell and Poth 2016; DeJonckheere and Vaughn 2019) hence it was deemed the best method for data collection of this study.

We the research team formulated a semi-structured interview guide, which contained questions on thematic topics related to work contents, context and conditions. This guide was used as a reference for the open-ended questions on the thematic topics under probe. The open-ended questions enabled participants to respond to questions as freely as they wished, and interviewers had the opportunity to probe, comment, ask follow-up questions, and expand on issues that seemed unclear for some participants. Consequently, interviewers were able to obtain detailed, manifest, in-depth data on participants' subjective viewpoints, including sensitive emotions, thoughts, perceptions, and experiences on the use of algorithms in their work.

Informed consent was obtained from all participants and all interviews were recorded using two different recording devices for back-up. The average time for the interviews was about sixty-five minutes. While their time was not incentivised, as an appreciation for their time, participants in Helsinki were given 10 euros whereas those in Tampere were given a token worth 10 euros. Ethical reviews were gained prior to data collection from the Ethics Committee of the Tampere Region (statements: 54/2020 and 61/2021).

Recruitment of participants

All participants of this study were, at the time of data collection, working as FDP workers in Platform X and/or Platform Y. This means that they had the ability to provide current information on their feelings, perceptions and experiences in their work environment. They were selected through purposive sampling as they were believed to have rich information relevant to this study topic and were able to elucidate the themes and concepts of the study. Purposive sampling is an approach for selecting participants with affluent and important information of a study (Campbell et al. 2020; Palinkas et al. 2015).

The first author met all participants in the city of Tampere on the streets during their work and recruited them for interviews. Their visibility on the streets was enhanced by their work gear (mainly company branded uniforms or delivery bags), which made it easy to be identified and approached for interviews. No interview was done instantly due to their tight work schedules, but they gave their phone numbers to be contacted for arrangement of an interview on a suitable time and date. On the other hand, recruiting participants who worked in Helsinki from the streets was challenging. Potential participants who were approached on the streets for interviews did not want to participate while some who left their phone numbers with the interviewers did not show up for the

Table 2. Summary of relevant social demographics of participants at the time of interview.

Social demographics		
Age	18 – 20 years old = 2/30	31 – 40 years old = 11/30
	20 – 30 years old = 16/30	40+ years old = 1/30
Gender	Male = 26/30	Female = 4/30
Family status	No children = 25/30	Family with children = 5/30
Ethnic origin	(im)migrant background = 29/30	Native background = 1/30
Duration of working in the platform	Less than 1 year = 11/30	Worked only in Platform X = 14/30
	1 – 2 years = 9/30	Worked only in Platform Y = 7/30
	2 – 3 years = 4/30	Worked in both Platforms X & Y = 9/30
	3 – 4 years = 3/30	
	4 – 5 years = 1/30	
	5+ years = 2/30	
Duration of work hours/week	Averagely 57 hours/week	
Number of work days/week	Averagely 6 days/week	
Main source of income	Courier platform work as the main source of income = 23/30	
	Other source of income as the main income = 7/30	

interview nor answer our phone calls. Thus, interviewers used Facebook groups to help recruit participants.

Both face-to-face and virtual interviews were applied. Face-to-face interviews were conducted either in the researcher's office or in a cafeteria, while virtual interviews were done through WhatsApp video call. Prior to interviews, informed consents were obtained from each participant by signing a form (for face-to-face interviews) or by allowing recording of the consent (for virtual interviews). Respect, privacy, anonymity, and confidentiality of participants were maintained throughout the study. Thus, participants were assigned codes (FC01 – FC30) which they were identified with, all throughout this study. Participants at the time of interviews are described in Table 2.

Data analysis

We employed qualitative content analysis to the data (Elo and Kyngäs 2008; Elo et al. 2014) for its procedural flexibility (Elo and Kyngäs 2008; Hsieh and Shannon 2005) and to identify better the 'core consistencies and meanings' (Patton 2002) in participants' experiences and perceptions around management by algorithms in their work. We applied JDCS framework as the analysis matrix to enable us to gain an in-depth understanding of the psychosocial stress and risks associated with work demands, control and support of AM. We continued the analysis by applying a directed content analysis approach, where we mapped inductive data in the analysis matrix (JDCS). Directed approach of qualitative content analysis is where an existing theory or prior research provides the structure of, and guides the analysis (Hsieh and Shannon 2005). Data analysis steps are illustrated in Figure 1.

Results

In this section, we report our findings based on the three components of the JDCS framework, which served as our analysis matrix. A summary of our results is provided in Table 3, while Table 4 describes a comparison of AM practices between the two FDPs in Finland.

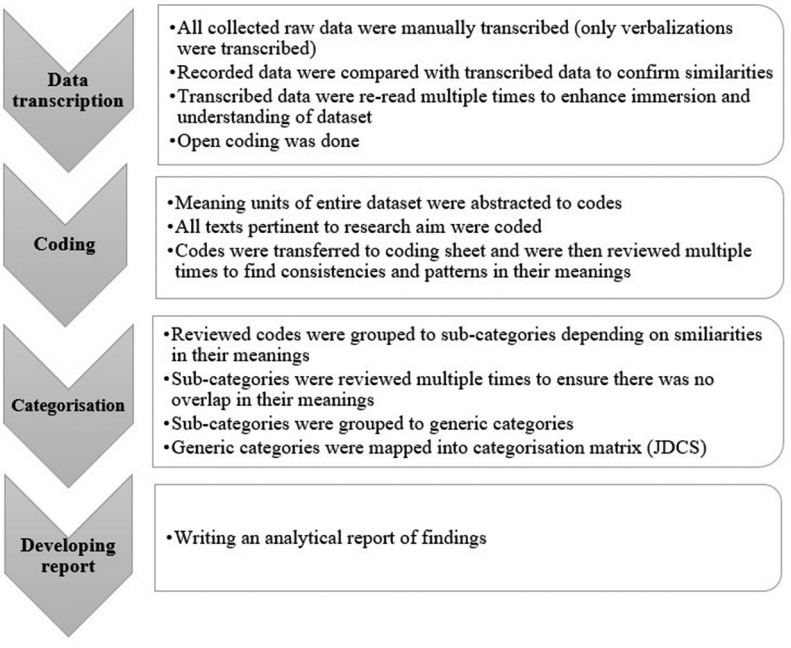

Figure 1. Steps of the data analysis.

Table 3. Results on experienced psychosocial hazards, risks, and stresses of algorithmic management.

Category matrix	Generic category	Examples of experienced hazards/ stressors	Experienced psychosocial stress/ outcomes
Work demands	Work pace	Fragmented work; high work intensity; work and income unpredictability; traffic violations.	Physical strain and exhaustion; financial stress; psychological stress.
	Workload	Work and income unpredictability; work-life imbalance; unsocial work hours; unequal work allocation; lack of transparency in the functioning of algorithms.	Physical strain and exhaustion; psychological strain and exhaustion; financial stress; feelings of unfairness and favouritism; wage and health inequalities.
Work control	Task discretion	Lower freedom over when to complete tasks; limited freedom on where to work; low latitude on delivery destinations; low latitude on delivery distances; limited authority over which task to execute; information asymmetries.	Psychological stress; frustrations; physical strain and exhaustion among bike couriers (in relation to longer distances); income loss; financial stress.
Workplace support	Organisational support	Loss of human interaction with supervisors; obstruction of feedback relevant to workers wellbeing; hinderance of recognition of couriers' efforts; lack of instrumental support.	Frustrations; Psychological stress.
	Co-worker support	Limited social interaction; limited workplace support.	Workplace social isolation.

Table 4. Roles of algorithms in the two platforms of study as perceived by participants.

Algorithmic role	Platform X	Platform Y
Work allocation	Algorithms allocated work to couriers who turned on their apps.	Algorithms allocated work to couriers who turned on their apps and were stationed at a specific location designated to them in the app.
Performance evaluation	Algorithms covertly evaluated performances of couriers – underperforming couriers were denied access to shifts.	Algorithms evaluated couriers' performances on the basis of set criteria and generated ranks for them based on how they performed. *Criteria/parameters of ranking were based on*: cancelling or missing shifts, work speed, rejecting/ignoring tasks, logging in to work from unassigned location, starting work more than five minutes after the start of shift, working on weekends.
Control the booking of shifts	Algorithms controlled the booking of shifts by allowing only couriers who worked within the criteria of evaluation to book shifts. These criteria were not told to participants but based their assumptions on their experiences.	Algorithms controlled the hours of shift work booked by couriers and ensured couriers did not book more shifts than agreed in their contract which was dependent on their migration status. Also, algorithms ensured that shifts were booked systematically according to couriers' rank levels.
Ranking and penalty	Indirect ranking was reported by participants. No direct penalties were reported by participants.	Algorithms generated ranks for couriers based on their work performance within the set criteria. Couriers who did not work within the criteria were demoted to lower ranks, making it difficult for them to access work.
Monitoring workers' work time	Algorithms monitored couriers' work time for purposes of payment.	Algorithms monitored couriers work time for purposes of generating ranks as well as payment.
Decided food delivery destination	Algorithms decided where couriers delivered food but offered couriers the latitude to decline the decision. Delivery destinations was displayed on the app before accepting the task	Algorithms decided where couriers delivered food but gave limited freedom to decline. Delivery destination was not shown to couriers until after they have picked the order for delivery.
Nudging	Algorithms sent push notifications to couriers to go to work on their off-days and to work in a particular area.	Algorithms sent push notification to couriers to work in a particular area.
Location monitoring	Algorithms monitored couriers' location for the purpose of task allocation and ensuring that couriers stayed in their working zones.	Algorithms monitored couriers' location for the purpose of task allocation, for ensuring that couriers stayed in their working zones and for purposes of generating ranks (by confirming if couriers were at the assigned location at assigned time).
Obstruction of work-related support	Management by algorithms reduced interaction among co-workers and platform personnel.	Management by algorithms reduced interaction among co-workers and platform personnel.

Work demands

Our results showed that AM in platform work generated psychological and physical job strains in relation to work pace and workload as we report in this section. We use work pace to mean the speed in which work is done and workload to mean the physical and mental strain perceived in regard to amount and duration of work (Hart and Staveland 1988).

Work pace

According to our data, both platforms employed algorithms to allocate tasks to couriers and evaluate their performances. This was applied differently in each platform and had varied consequences on couriers (see Table 4). However, interviews suggested that these practices increased work pressure among participants.

Participants who worked in Platform Y described an algorithmic evaluation of their performances which was based on certain parameters, with the consequence of algorithmic penalty – lowering them to lower ranks which was characterised by limited or lack of access to work shifts (see Table 4). Some participants reported that working within these parameters forced them to work at a high pace, executing tasks quickly within the specified time for task execution, which was psychologically stressful. They noted that failure to complete tasks on time subjected them to automated algorithmic penalty, creating financial risk and additional stress.

This pressure of working within the parameters of the evaluation system also presented challenges related to wellbeing and safety at work among couriers who worked in Platform Y. Participants who worked in this platform mentioned an intrinsic pressure to be on the top ranks, which fuelled competition among them and a race against each other. Consequently, they worked very fast and had challenges looking after their wellbeing at work, including traffic safety. Echoing other participants, 'FC19' explained: *'This (evaluation system) makes me in competition with all other Platform Y guys: like I need to run, I need to make more deliveries. . . but if there is not badge (rank) then I am happy with ten euro, I am just staying and doing slowly, like taking care of my health, I don't need to be on the street too long, no back issues, I need to pack my car properly, I need to see left and right, no accidents, and no health issues are coming up. . .Platform Y keep competition among guys'*.

These examples show how algorithmic evaluation of couriers' performances made work intense for couriers in this platform, exposing them to psychological and financial stress and risks, as well as health, well-being and safety risks. On the other hand, our interviews indicated that Platform X had a covert evaluation of couriers' performances which did not influence participants' work pace and thus was not stressful in this respect.

Algorithmic task allocation was reported for both platforms and was based on couriers' proximity to restaurants. Interviews indicated that this system directly and indirectly influenced work pace and had physical and psychological implications among couriers. For example, many participants who worked in Platform X reported allocation of fragmented tasks in which they mentioned being assigned only one task at a time. This pressured them to work 'very fast' so as to switch to the next task to complete as many tasks as possible for maximum income. They perceived that the algorithmic system of work allocation intrinsically pushed them to work at a high pace, as was well-articulated by 'FC17' who stated: *'at the end of the day people rush a lot, the system makes us to really rush. . . you have to be very very fast. If you are not fast, you will never be able to survive'*.

Interviews suggested that work fragmentation (mentioned above) led couriers to cycle or drive back and forth. Bike couriers found this physically exhausting due to high work intensity while car couriers experienced financial losses on shorter distances. 'FC07' for example, felt that task allocation system was unfair, time-consuming, and less rewarding. He explained: *'. . .they (Platform X) have changed the task distribution system which become unfair to some. . . since last few months, it started happening that you would get one task, you would go pick, deliver, pick deliver, which takes more energy and time. At the end of*

the day, it gives you less money. . . you go 1 km, drive one hour, then come back, park your car, go to restaurant and take food, and come back, and go drive again. So it's more time consuming and less rewarding'. Contrary to Platform X, Platform Y couriers reported being allocated continuous tasks, which minimised strains related to allocation of fragmented work.

Further, interviews indicated that couriers faced time pressure to accept tasks within 30–60 seconds. Accordingly, in Platform X, delays in accepting tasks within this time led to losing the task to another courier, which meant loss of income. For Platform Y couriers, delays not only shifted the task to another courier, but they also risked the algorithmic penalty, which they said was stressful. This pressure to respond quickly to deliveries was psychologically burdensome for some participants.

Workload

Interviews indicated that the algorithmic task allocation directly and indirectly influenced workload among our participants. They experienced high workload which was indicated by the duration of work. This subjected them to physical and psychological strains, as well as psychosocial implications related to work-life domains.

Interviews showed how allocation of fragmented tasks (mentioned above) increased pressure for high workload among participants, prompting them to 'work more' by staying at work for longer hours and many days in a week to maximise their earnings. Based on interviews, the evaluation system of Platform Y intrinsically pushed couriers to high workload, working also in unsocial hours to attain or retain higher ranking. Being in higher ranks meant work availability, unlike being in rank 3 and below which were associated with limited or no work. This was illustrated by 'FC11' who explained why he worked without rest day: *'Yeah, I am working more because I am going to get the good ranking position.'* Also, interviews indicated physical and psychological strains resulting from the high workload though were reported mainly by bike couriers.

Ostensibly, the timing of high workload hours implied work-family-conflict among couriers with families as they spent much time at work, including working in unsocial hours. They reported having insufficient time for their families owing to longer work durations, which was fuelled by the unpredictability of future tasks and income. For example, in response to whether they had enough time for family, friends and hobbies, 'FC06' who lived with his family and worked in Platform X said: *'No, it is not enough now. I think not enough time with my family. I spend time with my child very rare, it's not good but I think in future I will work less. . . . I try to spend time with them, but not enough'*. On the other hand, work-life balance among participants who did not have families varied. Some reported insufficient time for non-work activities due to high workload, while some mentioned creating time whenever they wanted. Interviews indicated that, those who reported work-life imbalance had higher income goals or needs and relied solely on courier work for their income.

Based on interviews, the algorithmic task allocation which was understood to allocate tasks to couriers based on their proximity to restaurants, showed unequal allocation of tasks among couriers. Some participants who worked in Platform X shared how some couriers received consecutive tasks than others despite waiting for tasks in the same

place. Similarly, some participants who delivered by car shared experiences of how, in both platforms some couriers were allocated more long-distance deliveries than their fellows. Some participants perceived these experiences as favouritism by algorithms, while some felt the algorithms were unfair in task allocation particularly due to wage inequalities it generated among them. Notably, car couriers emphasised the significance of long-distance delivery compensations, which significantly supplemented their income compared to pay-per-delivery earnings. For example:

> FC05: I think algorithms is good, but its sometimes very strange. . .Sometimes we are sitting with other colleagues in the same place, one has done 3 orders and the other one not even a single order. Sometimes it can just favour somebody, I don't know how it happens.
>
> Interviewer: Ok. And how are your tasks assigned?
>
> 'FC07': They say that the system calculates your location and your task location and then it gives to you. But I would really highly doubt that. . . Because system is never biased. System does not put you in one kind of loop. . .The people who are tasked in the city centres, they feel they are stuck in the city centre the whole day. The people who are delivering to long distances which pays you more money, they will be getting the long distances for the whole day. . . it becomes unfair. So the system should divide almost all the tasks equally so there is good balance for everyone. So one person does not feel bad about being stuck in the city centre and getting paid less'. . . . it should be fair and equal to everyone. Sometimes yes, it is unfair.

These experiences of participants showed how unfairness of algorithms can enhance wage and health disparities among couriers. While such inequalities can also increase workload among some couriers, lack of transparency in their functioning was also realised. Thus, some participants like 'FC10' regarded transparency in the functioning of algorithms as a psychosocial benefit. When responding to ways of improving his well-being at work, he said: '*if the algorithms could a bit more open, like we could see how tasks are assigned so to make us see that they are really fair because we cannot prove that they are fair. They should show us that if we are getting these tasks it's because there is nothing better, so people will not suspect that they may be unfair. So there can be more openness- that could be good.*'

Work control

According to our data, AM influenced task discretion among couriers in both platforms, limiting their autonomy over tasks in planning, organising and executing tasks. In other words, freedom on when, where and how to work, as well as which tasks to complete as we report in this section.

Autonomy in planning and organising work

Planning and organising work involved the extent to which couriers influenced the decisions of their work schedule, in other words, when to go to work. As all our participants worked as freelancers, they would be expected to be in full control of their work time. Indeed, interviews showed that couriers in both platforms had the latitude over when to work. They chose own suitable shifts (mainly in Platform Y but optional in Platform X) and worked at their preferred times in Platform X. However, our results

suggest that algorithmic surveillance and performance evaluation reduced this freedom particularly when they worked in shifts.

Our interviews showed that algorithms in Platform Y evaluated couriers' performances and ranked them, thus affecting their ability to secure their preferred shifts (see Table 4). Lower-ranked couriers had limited discretion over work time and were compelled to accept shifts irrespective of their suitability. Being the last group to book shifts left by those in upper ranks, they often settled for less desirable options due to limited availability, and sometimes there were no shifts left for them, thus resulting in stress and financial concerns among them. For example, for 'FC28', this situation was like an indirect account deactivation. He said: *'you know they have groups like 1,2,3,4 and group 4 or 3 you are not able to get more shifts. Those in group 1 are able to get shifts but group 3 and 4 they are not able to. So in that case then definitely I can lose my account because being in group 3 or 4 is like a deactivated account'*.

Contrarily, our interviews showed that while algorithmic evaluation of couriers' performances was not conspicuous in Platform X, it was covertly employed. Thus, couriers' latitude in booking shifts was limited. Our interviews suggested that working in shifts involved meeting a high level of work performance as only 'qualified' couriers were able to book shifts. Notifications regarding shift eligibility was shown to them in the app's shift-booking section, which indicated whether they qualified, did not qualify or no longer qualified for it. Those who did not 'work hard' were not eligible for shifts as was clearly articulated by 'FC17': *'with Platform X, you get the shifts based on how hard you have worked because they don't give the shifts to the people that haven't worked so hard'*. Noteworthy, specific criteria for this eligibility was unclear for Platform X couriers as it was not directly communicated to them. Our interviews indicated that they formed these assumptions based on their experiences of their interactions with the platform's app.

Above examples highlight the crucial role of algorithms in evaluating couriers' performances, which directly impacted their work schedules and reduced their autonomy over when to work. Interviews showed how algorithmic surveillance and evaluation in Platform Y further limited couriers' control over their work time, leading to sickness presenteeism for fear of being penalised. Also based on interviews, the system automatically penalised couriers for being late, or missing shifts regardless of the circumstances and despite informing the platform, which felt stressful and unfair for them. For example, 'FDP05' recounted: *'. . .I was always in badge 1, but one time I signed in late, and they put me to badge 3. . .They have this punishment system. I got angry why they put me in badge 3, I didn't have any enough work'*.

Notably, participants in Platform X emphasised that working in shifts was optional, allowing them greater flexibility to work whenever they desired. This contrasted with Platform Y, where working strictly in shifts was the norm. Despite this higher flexibility among couriers in Platform X on when to work, some of them reported algorithmic nudging in form of push notifications during their off days, urging them to go to work and 'make more money' that 'it's busy in the centre'. Some participants felt that these notifications reduced their latitude on when to go to work, by urging and pressurising them to work even on their off days. While some appreciated the motivation to 'earn more money', some felt frustrated and were disappointed when work did not turn out to be as busy as suggested. For example, 'FC21' said: *'sometimes when you're on an off day, you*

don't intend to work, sometimes they will send the message to come to your phone, "it's busy in the city centre". Maybe you are not intending to work, but that message can trigger you to go to work . . . Maybe that was the off day but automatically you will have to change your mind'.

Discretion on task execution

Our interviews showed that the algorithmic systems of the platforms limited couriers' latitude in relation to task execution. Tasks were displayed on couriers' screens with brief details about the task which participants noted were essential. They noted that such information not only made their work efficient but also helped them make better choices relevant to task execution. However, interviews indicated that the scope of the information varied between platforms. In Platform X, some participants noted that these details were not only limited to pick-up locations but also included delivery distances and destinations of tasks, which helped them to decide whether to accept tasks or not. In contrast, couriers who worked in Platform Y did not have the freedom to make such decisions as information on delivery location was only revealed after accepting the task, forcing them to commit without knowing the distances involved.

Further, our interviews showed that algorithmic system of Platform Y limited couriers' discretion over which tasks to execute due to lack of options for rejecting or cancelling tasks. Rejecting tasks lowered their ranks. Also, they were put on a mandatory unpaid break if they ignored tasks thrice in a row, which also eventually lowered their overall ranking. These experiences were reportedly stressful, increased financial risk and felt unfair.

For couriers who delivered by bike, this implied multiple burdens of stress especially when allocated long-distanced deliveries. For instance, for 'FC08' who delivered by bike, lack of this latitude was not beneficial but stressful when allocated a long-distance delivery. He said: *'another thing is when we get longer distance delivery. . . in Platform Y, we can't see the location for a certain order, but sometimes it happens if you cancel 3 times you will get a break. So, there's that thing for Platform Y. Platform Y is not for us any benefit and is not helpful'*. He further recalled how stressed he was when Platform Y once assigned him a task of longer distance and was not allowed the freedom to cancel it: *'it happen that we get longer distance and the support says that you have to go otherwise there is no way, you have to go. So that time I was really stressed. I am bike rider, so if you send me 3kms long distance it's unfair to me'*.

On the other hand, interviews indicated that Platform X couriers had the freedom to reject or cancel tasks. However, those who worked in shifts were tightly monitored by algorithms, thus decreasing their autonomy around task execution. In fact, on the ground of interviews, shift workers were expected to complete all assigned tasks without rejections or cancellations. Our interviews brought up that sometimes platforms called couriers urging them to accept the tasks which for some couriers, felt like a pressure for task execution. For example, 'FC15' recalled when a Platform X personnel called him after he ignored an allocated task twice, requesting him to accept the task. He mentioned: *'. . . delivery was flashing up on my phone and I didn't wanna take it, but then they rang me up and that's when they said, please can you take the delivery'*.

These experiences of participants show how algorithmic management limited task execution in the two platforms, but also that some aspects, such as not knowing destination before acceptance of the task, were felt particularly stressful.

Freedom within work location

Our interviews indicated that participants' working areas were divided into zones where they strictly worked in, and that the desire to change work zones or city required a new work application. This larger working area is not the focus here but the locations within the working zones.

Interviews, showed how constant algorithmic surveillance and nudges limited participants' latitude in choosing their work locations, thus generating stress and frustrations among couriers. Although the extent of this freedom differed between these two platforms, interviews showed that couriers in both platforms received phone alerts from the platforms when they happened to drive or cycle outside their allocated work zones. This illustrated how algorithmic monitoring limited their freedom of movement within work areas.

Interviews brought our attention to how couriers' freedom in choosing where to work was limited in Platform Y due to pervasive algorithmic surveillance. Participants who worked in this platform mentioned starting work in a location assigned by the platform and were constantly monitored. Their app would not register them as 'present at work' if algorithms detected that the location they started their work was different from the assigned location. Consequently, couriers were automatically marked late for work, which lowered their ranking.

> 'FC08': They are watching the place where I am now. And if I not going to this area which is the selected in apps, if I not be there the app is not going to start that you are working.

> 'FC28': So, if you are not in the location assigned to you, they will mark you late and in that case your ranking goes down and you can't book the shifts in the next two weeks.

Although in Platform X couriers started work at their preferred locations, constant location surveillance was apparent during shift work, limiting their freedom over work location. Thus, some shift workers felt controlled by the platform for constant monitoring and being required to wait for tasks in specific areas. Participant 'FC17' frustratingly recalled how Platform X personnel called him during his shift and 'ordered' him to wait for tasks at a particular location: *'sometimes they try to control you like a worker, . . . they like to call you like oh, you have to go here, you have to do this, but in reality we are not a worker, so nobody should control you where you have to work and where you don't have to work. There was an instance whereby I was called once that I am on shift so I have to go to the centre to look for delivery, but I'm like no, I am not going anywhere because you cannot order me where I have to go and where I don't have to go'*. He also recalled a different incident, when he was notified of being blocked from booking shifts for not having waited for tasks in the location where he was directed to wait. He said: *'so, one other time also they decided to cancel my possibility of getting shifts. So, they called me they told me ok, we are going to ban you, you are not going to get any more shifts . . . '* Notably, tight location monitoring was not reported when working without shifts in this platform.

Limited freedom in choosing where to work was also influenced by algorithmic nudges via push notifications as was reported by some participants who worked in Platform Y. Interviews showed that they received push notifications directing them to wait for tasks in specific areas, which restricted their ability to choose where to work. This decreased their latitude in deciding where to work or wait for tasks. Additionally, some participants

noted inaccuracies in location monitoring as they were nudged even when they were already in the designated areas. The constant nudging was felt annoying by some participants who worked in this platform. 'FC10' for example, felt 'pushed'. He said: *'. . . the system doesn't work very well and sometimes it pushes me, saying "hey, go to the centre of your area" even if I am already there. So, if you get a bit further from the centre it tells you to go to the centre'*.

These experiences illustrated how AM influenced spatial freedom by controlling couriers' workspaces, thus limiting their freedom over work areas.

Workplace support

This category discusses the degree to which couriers regarded the importance of workplace interactions and support from platform/supervisors and co-workers. Below we report our findings regarding organisational and co-worker support.

Organisational support

Our interviews indicated that the algorithmic system of management limited organisational support for couriers on matters not directly related to delivery, while support on issues directly related to deliveries was swift and adequate.

Based on our interviews, couriers had limited communication with platform personnel as they mainly interacted with the app, managed by algorithms. This lack of dialogue prevented discussions, which aimed at improving their wellbeing and performance such as providing feedback on their work. The idea of feedback varied slightly among participants. While only few participants regarded their salary or tips as their feedback, many participants perceived the platforms provided them feedback only when customers complained and that the feedback was often negative and indicated that the platforms sided with customers. According to these participants, they were unable to see customers' feedback about them, prompting feelings of one-sided feedback which they felt was annoying.

Interviews showed that AM hindered physical interaction between platforms and couriers, thus limiting organisational support. Participants explained how they mainly communicated with platforms through the chat box that was integrated in their apps, with Platform X also offering a call option. Couriers were frustrated by the lack of in-pers. comm., particularly during miscommunication or unanswered queries. They resolved work-related issues independently without assistance from the platforms which made them feel unimportant to platforms. 'FC17', for example, felt that platforms were selfish and only 'used' them for profit generation. He said: *'Platform X doesn't have any time to listen to these kinds of complaints (referring to couriers complaints to platforms on issues affecting them at work). It's about how we can deal with it ourselves. Sometimes I feel like they are always being selfish, and then it's always about how they can make their profit. When they are making their decisions and everything it is always about how it is going to benefit them . . . '*. Notably, having no human supervision was perceived positively by many participants but was felt stressful only when their work-related issues outside deliveries were not (sufficiently) responded to by the platforms.

Our interviews brought attention to how AM was related to recognition of work efforts among couriers, which is crucial in enhancing psychosocial wellbeing. Some of our

participants who had worked longer in the platforms felt unappreciated by the platforms for their 'hard work' and loyalty to platforms, making them feel that their work efforts were invisible to platforms. For example, 'FC07' who worked in Platform X felt unfairly treated by the platform for not rewarding him for the efforts and commitments he put in the work also during extremely bad weather seasons which challenge courier work. He said: *'Treated unfairly yes… sometimes, yeah, it's unfair. Let's say we are working in −27 degrees, and then you don't just see any like good return, good reward at the end of the day. It's like working in + 20 or −20 degrees is the same to them (Platform X) like they (Platform X) don't care'*.

The interviews showed that limited interaction with the platforms, coupled with enhanced interaction with algorithms on the platforms' apps, impaired couriers-platform relationship as some couriers did not feel human connection with their 'employers'. For example, when asked to describe their relationship with the platform personnel, 'FC07' responded: *'poker face, like not person at all'*.

As we noted in our data, although platforms did not help and support on work-related issues that did not concern deliveries, many participants who worked in Platform X appreciated it for offering emotional support.

Co-worker support

Our interviews indicated that AM minimised co-worker interactions and increased workplace isolation among couriers. Couriers mainly interacted with the app, which instructed their work through algorithms, thus limiting physical interaction among them. Although sometimes they waited for tasks in the same place, the AM system heightened work pace (mentioned in previous categories) which limited time for them to engage in conversations that would improve their working conditions. 'FC07' for example, when asked whether he interacted with co-workers, he said: *'Yeah, sometimes. You know Platform X is such a job that you have to be on your toes, you don't get to talk to your colleagues'*.

Consequently, some participants who worked in Platform X joined online social groups where they discussed work-related problems, sought for help and mutual support from fellow couriers. 'FC04' mentioned creating such a group which according to him was important to fellow couriers especially following the increased co-worker social isolation and lack of workplace support from the platforms. While some couriers found emotional support from co-workers in these groups, or directly from those they knew at a personal level, some participants did not see the need for being in such groups whereas some were unaware of their existence. Platform Y had a WhatsApp group, which was created by its management for the purpose of swapping shifts among couriers. Interviews showed that couriers also used this group to vent about their work-related experiences, though the platform's personnel did not participate at all in their conversations.

Discussion

This study examined the psychosocial stresses and risks associated with work demands, control and support of algorithmic management [AM] in food delivery platform [FDP] work in Finland. We drew our results from the experiences and perceptions of couriers who worked in the main FDPs in Finland. The findings showed a difference in the AM systems of these two platforms. The study indicated that one platform employed 'hard'

algorithmic control techniques, which involved pervasive surveillance of couriers' and was based on algorithmic evaluation of couriers' performances, and penalties of lowering rank levels. On the other hand, the other platform applied 'soft' algorithmic control techniques over its workforce. Despite these differences, this study has demonstrated that both AM systems had direct and indirect intertwined psychosocial implications on couriers. However, the psychosocial impacts depended on the way AM was employed and the consequences involved.

The study suggested that compared to couriers who worked under soft management practices, those who worked under hard algorithmic management techniques were exposed to multiple layers of stress and higher psychosocial risks due to the consequences of the evaluation system. According to Park et al. (2021), algorithmic evaluation can present burdens of psychological and social challenges among workers. Moreover, an extensively algorithmically controlled workforce and extensive application of performance appraisals can generate psychosocial risks such as stress, frustrations and mental distress among workers (Baiocco et al. 2022). Indeed, our results showed that working under the parameters of algorithmic evaluation added extensive stress among couriers by making the work more intense and substantially decreased couriers' overall workplace autonomy.

Our study demonstrated how algorithmic penalty increased precarity among couriers, generated stress and pressure to accept bad gigs. At worse, this can instigate destructive deviant behaviours among workers in their attempts to avoid the automated penalties, which can be psychologically burdening, as was found among gig workers in a study by Zhang and colleagues (2023). Such behaviours related to hard algorithmic control have also been reported by Heiland (2021) which showed that couriers engaged in resistance behaviour to hack the algorithms. Although our study did not find such behaviours, Tuomi et al. (2023) found similar practices among platform couriers in Helsinki, Finland. Evidently, restrictive AM can impel workers to psychologically burdening behaviours, which can in turn expose them to even worse psychosocial risks depending on the behaviour.

Precarity engendered by AM in FDP work has been highlighted in other studies (for example De Oliveira and Junges 2023; Goods et al. 2019), which found that some FDPs' rating systems would suddenly block couriers from the platforms without notice if they received unsatisfactory ratings from customers. While such practices generated anxiety and frustrations among couriers, they can increase risks for financial and job insecurity. In our study, none of the platforms relied on customers' ratings for the evaluation of couriers' performances. However, the evaluation criteria for couriers who worked under hard algorithmic control techniques in our study are, for example, mirrored in the works of Jesnes (2023). Like in our study, the study also reported feelings of unfair judgements by algorithms among couriers in this respect.

Further, this study demonstrated that the context in which algorithms were applied by the platforms exposed couriers to precarious working conditions, inherently increasing the quantitative demands of work. As a result, couriers with families faced work-family conflicts, often tempted to work during unsocial hours, which is a potential time for family. At the same time, the study showed that couriers had the discretion to choose when to work which can be argued to moderate the balance between work and personal life. Although this finding may be confusing, previous studies on platform work (for

example, Keith et al. 2020; Piasna 2023), have also found that workers who work under AM may experience increased work pressure towards incessant availability at work, which may challenge the work-life balance. While they may technically have autonomy over their work schedule, scheduling work and personal life to enhance work-life balance may practically become challenging (Anwar and Graham 2020; Cano et al. 2021). This autonomy presents a double-edged sword for the psychosocial well-being of couriers, potentially either enhancing or impairing their mental health and overall well-being (Mbare 2023). High workload among FDP workers can also affect health and safety and is a risk to traffic safety owing to its association with fatigue, stress and anxiety as has been established in previous studies (for example Christie and Ward 2019; Gregory 2021).

An insignificant but crucial and noteworthy finding in our study was the covert evaluation of couriers' performances working under soft management techniques. This revealed lack of transparency as parameters of the evaluation system were unclear and hidden from couriers, thus only second-guessed how they were evaluated. This can generate psychological burden, stress and frustrations when workers try to figure out how to work or behave in a manner that is favourable for positive outcomes as was echoed by Gregory (2021). Additionally, workers may feel powerless when they lack a clear understanding on the functioning of algorithms in relation to their work (Howard 2022; Kellogg et al. 2020. Furthermore, lack of or low transparency can also undermine organisational trust which is a predictor of psychosocial stress (Berastegui 2021). These were also apparent in our study when couriers did not understand the parameters under which they were allocated tasks which generated feelings of unfairness and doubts towards the platforms. We noted that in general, couriers' inability to contest the decisions of the AM increased their psychosocial vulnerabilities. The assessment metrics used for evaluation decisions were not transparent, nor were they accessible for them to review thus were unable to verify the decisions of algorithms and accuracy of its functioning. Their experiences of its inaccuracies and perceived inequalities, coupled with lack of human touch during critical moments, heightened stress, frustration, and mistrust towards the platforms. These underlined the need for transparent and accountable AM system for platform couriers.

Our study focused on stresses and risks of AM. However, it is essential to note that stress varied among respondents, with some finding certain aspects of AM more stressful than others. Also, some participants appreciated some elements of AM. Considering our findings, it is safe to say that perceived negative impacts of AM outweighed the positive influences. This predominance poses significant psychosocial risks to couriers, which can undermine their wellbeing thus challenging the viability of 'independent contractor model' under AM. Furthermore, in contrast to employed platform workers who have labour market security to help mitigate the psychosocial challenges of AM (for example Selberg 2023), platform work and the rise of self-employment erode workers' rights in Finland's traditionally extensively regulated labour markets. Nevertheless, we deduce that the newly established couriers' association (see PAM Couriers Finland 2023) could prove a means to challenge the most unfair and stressful practices of AM without risking anyone's individual work opportunities.

Efficiency and effectiveness of algorithms in eliminating biases in workplaces and enhancing fairness among workers has been highlighted in the literature (for example, Jabagi et al. 2020; Newman et al. 2020). However, this was not entirely the case in our

study. As we have demonstrated thus far, prevalent in the three domains of analysis is how AM generated unfair practices among couriers, information and power asymmetries, as well as increasing precarious work conditions among couriers. These do not only exacerbate (the risk of) acute psychosocial distress but can contribute to the development of chronic mental health conditions such as anxiety disorders and depression. As these findings suggest that the benefits of efficiency and effectiveness of algorithms may not always materialise in practice, this requires a critical re-evaluation of their role in enhancing the health and wellbeing of workers working under such management techniques. AM can be employed effectively in platform work without having to compromise the health and wellbeing of workers. Transparent AM practices and well-designed control and surveillance mechanisms can balance job demands with adequate control and support, to mitigate psychosocial risks and reduce workplace stress.

Application of JDCS model in platform work

This model emphasises the importance of workplace social support in balancing job demands-control to reduce work stress. A challenge we see about the application of the JDCS model in the study of platform work is that couriers under study were, at the time of this study/interviews, working as independent contractors. We think that this can challenge the dimension of organisational support for them, as they would be legally expected to take care of their own risks. On the other hand, they worked as partners with the platforms and worked under the algorithmic instructions of the platforms. In this context, it can be expected that the platforms would provide them organisational support or design their algorithms in a way that can offer such support.

Understanding the psychosocial implications of AM within the JDCS framework is essential for addressing potential impacts on workers' wellbeing. Based on our study, we can conclude that, although JDCS work stress model was not founded for algorithmically managed jobs, it can fit well to the study of such work environments. Therefore, as our study did not involve quantitative elements which could precisely verify this, we recommend a study that will quantitatively investigate the psychosocial influence of AM in relation to Job-Demands-Control-Support. Also, the future studies should pay attention on the limits for organisational support for FDP workers when they are working as independent contractors. We studied one widespread platform worker group, but it is also important to examine if the lessons of this study fit to other platform work categories.

Study limitations

This study has limitations. Firstly, it is based on the viewpoints and perceptions of (im)migrant couriers owing that twenty-nine of the thirty respondents were unintentionally of migrant backgrounds. However, their perceptions and experiences were similar to the one native respondent whom we interviewed. Moreover, though our respondents were mainly migrants, they were from different continents. This reduced participant bias in relation to culture (cultural bias).

Secondly, owing to heterogeneity of platforms and differences in the management systems of platforms (for example Griesbach et al. 2019; Veen et al. 2020), these results may not be generalised to all forms of digital labour platforms that rely on AM. Furthermore, although the

platforms in this study are global companies, their operations may vary across countries due to differences in regulatory contexts, which requires them to adapt their practices accordingly. This could impact the extent to which AM is applied in the management of workforce. Therefore, these results, which are based on the experiences from Finland, may not fully apply to contexts where food couriers are classified as employees rather than independent contractors. Additionally, this study relied on subjective indicators from a sample of 30 respondents. Thus, while the results provide substantial insights on psychosocial influence of AM, they cannot be generalised to the entire population of workers who are managed by algorithms.

Lastly, platforms have the tendency for frequently changing their business models and practices (Alsos and Trygstad 2018; Mendonça and Kougiannou 2023). This was also apparent in our study and changes were mentioned by some of our participants who had worked longer in the platforms. Therefore, there may be no certainty on the implications of any changes occurring between the time of our interviews and the time of writing this.

Conclusions

This study examined the psychosocial stresses and risks associated with work demands, control and support of algorithmic management [AM] in food delivery platform [FDP] work in Finland. The study established that, while the AM techniques employed by the two platforms differed in terms of impacts, AM can create an imbalance in job demands-control-support. Couriers experienced high quantitative work demands, low control over work as well as low workplace support. Management by algorithms directly and indirectly generated psychosocial hazards, which exacerbated psychosocial stress among FDP workers in Finland. Couriers were exposed to algorithmic practices which engendered profound power imbalance between them and the platforms. This did not only increase precarious work conditions among them, but also engendered unfair practices, information asymmetries, and psychosocial inequalities which were exploitative to couriers and detrimentally challenged their psychosocial wellbeing.

These outcomes are not inevitable as they are largely dependent on the context of the job. Therefore, to reduce both societal and psychosocial impacts, platforms can programme or design their algorithms in a manner that could yield more positive psychosocial outcomes on their workers. In doing so, it is imperative that they: (1) decrease the algorithmic hazards related to quantitative demands, (2) implement algorithmic practices which will enhance the levels of control that couriers have over their work, and (3) increase the level of workplace support. These could mitigate perceived algorithmic hazards and balance the work demands-control-support. Secondly, trade union can be a collective actor and be a more equal counterpart to platform companies. Thus, there is potential for influencing these practices, which are of crucial significance to thousands of couriers in Finland. Thirdly, as AM has started expanding across conventional workplaces, we expect that psychosocial risks will continue to rise among workers working under AM practices. New risks may emerge, and existing risks may worsen in the light of continuous advancements in technology and change in the AM systems. However, it is possible to mitigate related risks and societal impacts through regulation of AM and employment practices in platform economy.

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Data availability statement

The data used in this study will be deposited as anonymised data, to the Finnish Social Science Data Archive. The anonymisation is in process. Before it is completed one may request the data from the second author of this study Dr. Mikko Perkiö, mikko.perkio@tuni.fi, who is responsible for the research projects that these data belong to.

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