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Aberrant driving behaviour among home healthcare workers

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A R T I C L E   I N F O

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A B S T R A C T

This study investigates how job demands, such as time and work pressure, as well as fatigue and safety climate are related to aberrant driving behaviour including inattention, speeding, and driving while tired among employees in the Norwegian home healthcare service. The analysis adjusted for demographics, such as age, gender, and years of employment. A questionnaire was devised using validated instruments and PLS-SEM was used to analyse the data which included 210 respondents from municipal home healthcare services throughout Norway. A multiple mediation analysis was developed and tested in a complex modelling framework. We conclude that (i) workers' job demands have a direct and indirect impact (via fatigue) on aberrant driving behaviour, (ii) taking measures to manage fatigue precursors may lead to less aberrant driving behaviour among employees in the home healthcare sector, (iii) work and time pressure are possible precursors of fatigue, and (iv) the importance of management's involvement in promoting a safe driving climate is emphasised.

1. Introduction

Increased life expectancy and health impairments by old age are causing rapid global growth in the home healthcare sector (World Health Organization, 2015). In Norway, for instance, there was an increase of home healthcare users of about 11% from 2016 to 2020 (Statistics Norway, 2021). Services provided by home healthcare workers include somatic health care through nursing, physiotherapy, and ergotherapy, as well as psychosocial help and supervision (Norwegian Health Services, 2019). Home healthcare workers are exposed to numerous work hazards, like blood-borne pathogens and musculoskeletal injuries (Hittle et al., 2016), slips, trips, and falls (Muramatsu et al., 2018), verbal abuse (Karlsson et al., 2019), and violence (Quinn et al., 2016). In addition to these risks deriving from their primary work tasks, they are exposed to road traffic risks because their work includes driving to and from patients. A study regarding the work time distribution among home healthcare workers showed that up to 43% of their time is spent in the vehicle, whereas 57% is spent at patients' homes (Van De Weerdt & Baratta, 2015).

Home healthcare workers are not only exposed to risks from other road users, but also constitute a risk in traffic. Previous work has shown that occupational conditions can affect employees' driving performance (Alonso et al., 2020). Time pressure, responsibility, job constraints, work-related fatigue, and shiftwork have been reported as risk factors for road traffic accidents in work settings (Caird & Kline, 2004; Chiron et al., 2008). Research on relationships between work-related risk factors and fatal road accidents found that excessive speed, time pressure, and fatigue were risk factors (Nævestad et al., 2015). Given that workers in home healthcare have reported both work overload and excessive time pressure (Andersen & Westgaard, 2013), mental exhaustion from work (Strandell,

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2020) and stress (Muramatsu et al., 2019), it is interesting to investigate if these factors have a relationship to aberrant driving behaviour in this sector.

Aberrant driving behaviour refers to error conduct and/or violations when driving (Reason et al., 1990). Errors refer to failures of planned actions to achieve intended consequences, whereas violations are deliberate deviations from what is considered safe practice. Both these underlying constructs have been associated with accident involvement in previous studies (de Winter & Dodou, 2010; de Winter et al., 2015; Shams et al., 2020; Rezapur-Shahkolai et al., 2020; Mehdizadeh et al., 2018, 2019). However, speeding, inattentive, and fatigued/tired driving seem to be of particular importance in accident causation. Therefore, these three will be the focal point of aberrant driving behaviour in the current study. Speeding has a clear connection with traffic accidents as speeding correlates with both crash frequency and severity of consequences (Papantoniou et al., 2022; Vadeby & Forsman, 2018; World Health Organization, 2021). Important sources of inattentive driving may for instance be cognitive load causing less effective visual information processing (Sundfør et al., 2019). Driver impairment deriving from lack of sleep or fatigue has also been related to less efficient information processing and lower alertness (Goel et al., 2009; Islam & Mannering, 2023).

There are several reasons why this topic is important to investigate in further detail. Firstly, the topic is related to health risks of both employees and others who may be exposed to road traffic accidents. Secondly, there is an international understaffing in the home healthcare sector (Gautun, 2021) and simultaneously a worldwide growth in the elderly population (World Health Organization, 2015). If there are more patients than the available staff can handle, the reported issues with time pressure, stress, and exhaustion will likely increase. If driving behaviour among home healthcare workers is negatively influenced by such stressors, then accident rates could increase as well. Thirdly, home healthcare workers are increasing the risks of accidents involving civilians if their working conditions make them more prone to aberrant driving behaviour.

To the authors' best knowledge, few studies have investigated aberrant driving behaviour specifically among home healthcare workers. The only study in this vein that we are aware of (Newnam & VonSchuckmann, 2012) had a much stronger focus on instrument development than on driving behaviour and its precursors in the target group. Studies that examine the link between working conditions and work-related road exposure are also scant (Fort et al., 2016). Further, there is a limited number of studies on nonfatal work-related motor vehicle crashes and little research on workers in light vehicles (Pratt & Bell, 2019). The current study will therefore contribute to these knowledge gaps as well.

The core aim of this study is to investigate whether there is a relation between aberrant driving behaviour in the home healthcare sector and work and time pressure as well as dimensions of work-related fatigue, and safety climate.

2. Work situation of home healthcare workers

Home healthcare workers provide health care for older adults and individuals with disabilities. The services take place in patients' homes and cover a wide range of healthcare services including general daily care (e.g., help with hygiene, toilet visits), medications and medical procedures as well as supervision regarding dieting and other health-related issues. The home healthcare sector has contributed to less institutionalisation and has improved the quality of life both for elderly and their significant others (Delp et al., 2010; Jang et al., 2017). Meanwhile, the job as a home healthcare worker is demanding, and the staff must visit many patients during a workday. There have been reports of high turnover intentions (Lee & Jang, 2016) as well as stress, fatigue, and strain among home healthcare workers (Hsu et al., 2007; Jang et al., 2017; Weilenmann et al., 2021). Such stressors may also be facilitated by emotionally demanding conversations that these workers have with their patients (Jang et al., 2017). Stressors caused by tight time schedules, emotional patient encounters, and demanding work conditions are, in turn, potential precursors of aggressive and aberrant driving (Useche et al., 2020; Kwon et al., 2019).

To the authors' best knowledge there are no country-wide statistics regarding home healthcare workers' annual mileage available in Norway. Hogseth and Fosnes (2015) estimated the annual mileage of the home healthcare sector in one Norwegian municipality to be about 700 000 km. This constitutes more than half of the total annual mileage driven by all municipality services in this specific region. Holm and Angelsen (2014) reported that the driving time ranged from 18 to 26% of the work time (equaling 6.75–9.75 h during a normal week of work in Norway) across two Norwegian municipalities. GIS analysis reflected strong variation in the distance covered during a day, ranging from an average of 29.60 to 39.20 km. The same study showed that even though planners of the driving routes in the home healthcare sector have knowledge of how much time is usually required for each visit, the driving time is usually underestimated. Failing to make realistic estimates of the time it takes to drive from one user to the next indicates that employees do not have sufficient control of the time spent in the vehicle during the day, which may affect the amount of time they have for their primary task, which is health care. This challenge is likely substantiated by the fact that Norwegian home healthcare workers drive all year including approximately six months a year with snow and ice conditions. Snow and ice may also complicate getting into the houses of patients. The fact that driving routes may change from day to day and that some patients may need several visits during a day adds to the unpredictability of the driving schedules in this sector.

Similar to most professional medical services, the home healthcare sector has a patient-centered approach, meaning that the work identity and ethical code are strongly constituted by the needs of the patients. A potential consequence of the conflict between their primary work task and, more secondary, driving task is that home healthcare workers focus on the ethical code and speed to reach their patients on time. Home healthcare workers do not generally work for provisions in Norway, but that does not exclude the possibility that working faster may be considered a reward. The reward could for instance be that violating safety rules, e.g., by speeding, can possibly create a perception of saving time so that workers are able to spend more time with each patient.

An additional factor that may hamper the workers' schedules is the fact that much of the driving takes place in densely populated areas with rather low speed limits. The workers also need to consider the presence of vulnerable road users, such as bicyclists and pedestrians. In the Norwegian setting these road users are in many ways at the top of the road traffic safety hierarchy and injuries caused by aberrant driving behaviour are associated with severe punishment for the drivers, particularly among those who depend on a driver's license for work. There are also other organisational factors that may influence driving behaviour among home healthcare workers. The workers often need to consult and coordinate with managers and colleagues throughout a workday, and this can lead to extensive telephone use in the vehicle. Even if this takes place using hands-free solutions, it is likely to take cognitive attention away from the driving task. In addition, the workers need to handle registration tasks after each patient visit, such as updating patient journals.

3. Theoretical and empirical framework

3.1. Job demands-resources model and aberrant driving behaviour

The job-demands resources (JD-R) model (Demerouti et al., 2001; Bakker et al., 2003; Schaufeli & Bakker, 2004; Bakker & Demerouti, 2007) proposes that all jobs include job demands or job resources (Demerouti et al., 2001). Job demands are physical, social, or organisational aspects of the job that require sustained physical or mental effort, and demands are therefore associated with certain physiological and psychological costs. Work and time pressure are examples of job demands. Job resources are physiological, psychological, social, or organisational aspects of the job that may be functional in achieving work goals, reduce job demands, or stimulate personal growth and development (Demerouti et al., 2001).

One of the further developments of the JD-R model has included personal resources as a part of what will affect the balance between demands and resources (Xanthopoulou et al., 2007; Xanthopoulou et al., 2009). This means that demands and resources, and their resulting processes, will affect workers differently depending on their personal resources, such as optimism, self-efficacy, and organisational self-esteem (Xanthopoulou et al., 2009). While stressors can elevate workers' probability of making violations for potential benefits of working faster (Starcke et al., 2016), the JD-R model also proposes that these stressors can make workers feel fatigued. Previous research has found relations between job demands, fatigue and aberrant driving behaviour (Useche et al., 2017; Strahan et al., 2008; Wang et al., 2019; Sabir et al., 2018). Frone and Tidwell (2015) investigated different definitions of work-related fatigue and found that all definitions of fatigue include aspects of extreme tiredness and reduced functional capacity. This reduction of functional capacity can further be separated into either physical, mental, or emotional fatigue. Physical work fatigue affects the ability to engage in physical activity during and at the end of the workday, mental work fatigue involves not being able to engage in cognitive activities during and at the end of the workday, and emotional work fatigue affects the capacity to engage in emotional activity during and at the end of the workday (Frone & Tidwell, 2015). Fatigue can affect driving behaviour because it affects the ability to perform effectively (Sabir et al., 2018). Fatigue has also been related to near-miss incidents in ambulance personnel and has thereby been related to high workload and unhealthy lifestyles like irregular sleep patterns and mealtimes (Toyokuni et al., 2022). The current study suggests a similar relation between job demands, fatigue, and aberrant driving behaviour in the home healthcare sector because home healthcare workers have reported stressors such as time pressure and work overload (Andersen & Westgaard, 2013), and symptoms of fatigue (Strandell, 2020).

3.2. Safety climate and aberrant driving behaviour

Safety climate is a job resource that serves as organisational support that may motivate the development of safety-oriented behaviours rewarded by the environment (Nahrgang et al., 2011). Griffin and Neal (2000) argued that safety climate should be conceptualised as a higher-order factor comprised of more specific first-order factors. First-order factors are perceptions of safety-related policies, procedures, and rewards, while the higher-order factors should reflect the extent to which employees believe that safety is valued within the organisation (Griffin & Neal, 2000). There are therefore two ways of understanding the concept, both how employees understand safety measures, and if they think practicing these measures is regarded as valuable by the organisation. Safety climate can be seen as the measurable aspect of safety culture (Huang et al., 2013). Safety climate has been related to safety knowledge, motivation, and safety outcomes (Christian et al., 2009). There is also extensive literature on occupational safety climate and its connection to work-related aberrant driving behaviour (Newnam & Watson, 2011; Amponsah-Tawiah & Mensah, 2016; Wills et al., 2009). Commitment to safety practices and regulations has for instance been an important part of an organisation's safety climate that can reduce workers' aberrant driving behaviour (Amponsah-Tawiah & Mensah, 2016). The importance of policies, practices and procedures has also been stressed by research that reported connections with safety climate and fatigue-related aberrant driving behaviour (Strahan et al., 2008). In addition, when employees experience involvement in decision making and feel important for the organisation they also report less driving errors and violations (Öz et al., 2010). A strong safety climate can moderate the effect of thrill and adventure seeking trait on driving errors, violations and driving while fatigued in occupational drivers (Wishart et al., 2017).

4. Our study's contributions

The current study will have three core contributions to the state of the art in safety climate and aberrant driving behaviour. Firstly, previous studies tended to focus on professional drivers while this study is conducted among light-vehicle workers who do not regard driving as their main task. Secondly, previous studies have used safety climate measures that are specifically directed towards driving, mainly the safety climate questionnaire-modified for drivers (SCQ-MD) (Glendon & Litherland, 2001). The current study will use a global measure of safety climate, which makes it possible to examine whether workplaces have to specifically focus on safety climate in relation to driving, or whether their general safety climate also applies to a driving context even when driving is not the main job task. Thirdly, to the best of our knowledge, there has only been one previous study that examined different dimensions of safety climate and their relations to work-related driving (Wills et al., 2006). Other studies have investigated safety climate dimensions in connection to crash involvement (Varmazyar et al., 2016) and safety behaviour (Safitri et al., 2019). The current study will advance the literature by showing which part of the safety climate is most important for aberrant driving behaviour, with the use of a safety climate measure that is universal and not specific.

4.1. Hypotheses

Summarised, theory proposes how job demands may negatively influence safety outcomes directly by predicting employee fatigue, which may also negatively affect safety behaviour. Job resources like safety climate may positively affect safety behaviour. This theoretical framework and the empirical research presented above shape the base of the hypotheses in this study. A working model that illustrates these hypotheses is presented in Fig. 1.

Hypothesis 1. *a) Time pressure, b) work pressure, and c) fatigue (physical, mental, and emotional) are positively related to aberrant driving behaviour (inattention, speeding, and driving while tired).*

Hypothesis 2. *a) Time pressure and b) work pressure are positively related to (physical, mental, and emotional) fatigue, and c) a positive effect of time pressure on work pressure is hypothesised, due to the type of work which requires strict time management.*

Hypothesis 3. *Safety climate (management safety priority, commitment and competence, management safety empowerment, management safety justice, workers' safety commitment, workers' safety priority and risk non-acceptance, safety communication, learning, and trust in co-workers' safety competence, and workers' trust in the efficacy of safety systems) are negatively related to aberrant driving behaviour (inattention, speeding, and driving while tired).*

Hypothesis 4. *Fatigue positively mediates the relations between a) time pressure and b) work pressure and aberrant driving behaviour (inattention, speeding, and driving while tired).*

5. Method

5.1. Procedure

The participants were Norwegian home healthcare workers from municipalities all over Norway. The study was cross-sectional and data collection was done through an electronic questionnaire. To recruit respondents, invitation emails were sent to department managers or contact persons of Norwegian home healthcare services. Email addresses were obtained from public information on municipal websites. 40 of approximately 147 asked home healthcare services responded that they wanted to contribute to the survey. The managers or contact persons from the departments that wanted to participate received a Uniform Resource Locator (URL) to the questionnaire and distributed this to the employees. The questionnaire was open from 14th October to 14th December 2021. A rough estimate of how many respondents the survey got from each home healthcare department is 5, which is based on the total number of respondents (N = 215) divided by the number of departments that responded positively to the inquiry (N = 40).

5.2. Ethics

The Norwegian Centre for Research Data (NSD) was contacted to ensure that the questionnaire was fully anonymous. This led to minor adjustments in the questionnaire. The respondents were informed that their responses would be anonymous and that submitting a completed questionnaire served as explicit consent to participation in the study. In addition to ensuring anonymity through the questionnaire design, internet protocol (IP) security was also ensured by using the "Nettskjema" platform which neither records IP addresses of the respondents nor delivers any data to third parties.

5.3. Instruments

The data were gathered with a self-devised questionnaire based on well-established measures.

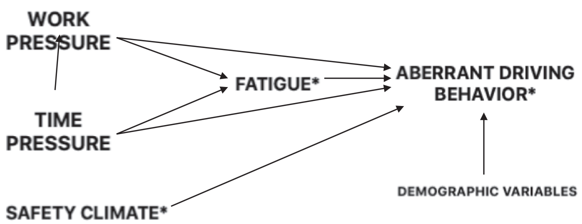

Fig. 1. Working model. *Note. Safety climate, fatigue, and aberrant driving behaviour consist of several dimensions.

Demographic information: The demographic measures used in the present study were age, gender, and years of employment. Years of employment were measured with how long the respondents had been working in home healthcare, which was categorised into four categories: 0–3 years, 4–6 years, 7–10 years, and more than 10 years. Gender was categorised as female and male. Age was categorised into four categories: 18–29 years old, 30–39 years old, 40–49 years old, and 50 years old or older.

Safety climate: Safety climate was measured with the Norwegian translation of the Nordic Occupational Safety Climate Questionnaire (NOSACQ-50) which was developed by a team of Nordic occupational safety researchers (Kines et al., 2011). The instrument used a five-point Likert scale. The instrument consists of 50 items, including both regular and reversed items, that can be sorted into seven dimensions. The first three dimensions are about the shared perceptions of management and the final four dimensions focus on the safety climate in the team. NOSACQ-50 is a reliable and valid instrument (Kines et al., 2011) that has been used in several different sectors, including research on workers in healthcare (Sepp & Järvis, 2019; Moda et al., 2021; Larsson et al., 2018). The instrument contains items such as "Management looks the other way when someone is careless with safety", "We who work here can talk freely about safety" and "We who work here consider that safety rounds/evaluations help find serious hazards".

Aberrant driving behaviour: Aberrant driving behaviour was measured using the Occupational Driver Behaviour Questionnaire (ODBQ) (Newnam & VonSchuckmann, 2012). This instrument was developed based on the Driver Behaviour Questionnaire (DBQ) which is a widely used instrument for examining self-reported aberrant driving behaviour (de Winter et al., 2015). The ODBQ is applied in this survey because it is more specifically directed towards occupational drivers and has been tested among healthcare workers (Newnam & VonSchuckmann, 2012). The dimensionality of the ODBQ consists of speeding, rule violations, inattention, and driving while tired. In this study, the dimension of rule violations was removed and a measure of violations from the DBQ was instead intended to be used because it was considered a stronger measure for rule violations. However, when starting the analysis, the violations measure from the DBQ correlated highly with the speeding measure from the ODBQ, and therefore the violations measure was removed. Speeding was therefore considered sufficient for driving violations. Nine items from the ODBQ were thereby applied and measured with a 5-point Likert-type scale from "rarely/never" to "very often". The items were translated from English to Norwegian by the second author. The ODBQ contains items such as "Deliberately exceed the speed limit when travelling to a patient or the office", "Drive while thinking about your next patient or work task" and "Find yourself nodding off while driving".

Work pressure: Work pressure was measured with items from the instrument Energy Compass (EC) (Schaufeli, 2017). The instrument is based on the Job Demands Resources model and is used to measure job demands, resources, outcomes, and personal resources. Work pressure is based on the items from "work overload" in the Energy Compass. The EC used these items from existing scales, and considerable evidence for the reliability and validity of the instrument was revealed (Schaufeli, 2017). The translation was undertaken by a group of experts in organisational psychology at the Norwegian University of Science and Technology (NTNU). The three items that make up work pressure are answered with a 5-point Likert-type-scale from "never" to "always". Examples of items are "Do you have to do many tasks at the same time? and "Do you have to work very rapidly?".

Time pressure: A measure of time pressure was developed by Beehr et al. (1976) with their construct "role overload". The items were originally measured with a 7-point Likert scale, but when Näswall et al. (2010) applied the measure, they used a 5-point Likert scale. This five-point version of the measure was translated to Norwegian as part of the Knowledge-Intensive Work Environment Survey Target (KIWEST) (Innstrand et al., 2015). The measure of time pressure used in this study applies the translated version from KIWEST. The measure consists of three items about time pressure, such as "I am given enough time to do what is expected of me at work" (reversed) and "I often have too much to do at work".

Fatigue: Fatigue was measured with Frone and Tidwell's (2015) Three-Dimensional Work Fatigue Inventory (3D-WFI). The instrument measures work fatigue with a physical, mental, and emotional dimension. The translation of the 3D-WFI to Norwegian was done as part of a master's thesis at the University of Oslo where the 3D-WFI was translated by their Work and Organizational Psychology research group (Knutsen, 2019). The inventory consists of 18 items and the three dimensions have six items each. The respondents answer the questions considering their past 12 months at work. Item examples are "During the past 12 months, how often did you feel physically worn out at the end of the workday?" and "During the past 12 months, how often did you have difficulty thinking and concentrating at the end of the workday?". The items are answered with a five-point Likert-type scale from "never" to "every day". The 3D-WFi is still a relatively new measure but was validated in a sample of 2477 U.S. workers (Frone & Tidwell, 2015). It has later been validated in both non-deployed military personnel (Frone & Blais, 2019) and German employees (Frone et al., 2018).

5.4. Statistical analysis

The data were inspected for suspicious response patterns, outliers, and data distribution (Hair et al., 2017). All items in the questionnaire were mandatory and missing data are therefore not an issue. There were no outliers in the dataset and normality issues were not present because the dataset consists of nominal and ordinal data. There were 215 respondents in the survey and five of these were deleted through data screening. The analytical sample is therefore based on 210 respondents. A multiple mediation analysis was developed and tested in a complex modelling framework.

5.5. PLS-SEM

Partial least squares structural equation modeling (PLS-SEM) was used for the statistical analysis in this study. The main difference between the PLS-SEM and the traditional Structural Equation Model (SEM) is how they estimate relationships between latent and observed variables. In traditional SEM, the relationships between the observed variables and their corresponding latent variables are estimated using maximum likelihood estimation, while in PLS-SEM, partial least squares regression is used for this purpose. PLS-SEM is particularly useful in situations where the sample size is relatively small, the data are non-normally distributed, or the model is highly complex. This is a more flexible approach that allows for the estimation of relationships between latent variables even when there are relatively few observations or when the assumptions of normality and linearity are not met (e.g., Astrachan et al., 2014). On the other hand, traditional SEM is generally preferred in situations where the sample size is larger and the data are normally distributed, as it provides more accurate estimates of the model parameters under these conditions. Another difference between the two methods is how they estimate the relationships between the latent variables themselves. In traditional SEM, the relationships are estimated using covariance or correlation matrices, while in PLS-SEM, partial least squares regression is used.

Although PLS-SEM has been considered a particularly suitable approach when using rather small samples of e.g., 100 participants, there are no clear-cut established statistical tests to determine the exact number of respondents needed in these analyses. Simulations show that PLS-SEM tends to yield substantially better power and lower Type II liability than co-variance based SEM across different sample sizes, and particularly below approximately n = 250 (Reinartz et al., 2009). Some researchers have suggested that the samples should have at least 10 cases per manifest variable for the larger of (1) the number of parameters among the latent factors or (2) the largest number of incoming causal arrows (exogenous variables) for the latent factors (Barclay et al., 1995; Chin, 1998). In the current study, the largest number of parameters among the latent factors was 8 (required n = 80) and the largest number of incoming paths was 15 (required n = 150). Hence, the present study conforms to the most used approach to determine power in PLS-SEM. We also allude to the fact that several recent surveys among home healthcare workers featured similar or even smaller sample sizes (e.g., Ruotsalainen et al., 2020; Sterling et al., 2022).

In addition, PLS-SEM is a feasible analysis approach for exploratory research and when developing theories because the method focuses on explaining the variance in the dependent variables (Hair et al., 2017). PLS-SEM also has a high degree of statistical power which is useful when conducting research which examines less developed or still developing theory (Hair et al., 2019). The basic equations for the PLS-SEM model are also shown in Appendix A. As PLS-SEM does not have a well-established global criterion for goodness of fit, the structural model is assessed based on heuristic criteria that are determined by the model's predictive capabilities. The coefficient of determination (R^2-value) is the most commonly used measure for the predictive power of the model (Hair et al., 2017). A lack of a general goodness of fit measure does not mean that PLS-SEM is inferior for theory testing and confirmation (Hair et al., 2019). The SmartPLS 3 software was used to analyse the data (Ringle et al., 2015). The software provides fit indices for PLS-SEM, however, the developers note that there is much more research needed for these indices to be applied appropriately and therefore recommend not reporting and using these on PLS-SEM results assessment ("Model fit", n.d). These fit indices are therefore not reported in this study.

The PLS-SEM model consists of a measurement model and a structural model. We used a two-step approach where a measurement model was first fitted. Thereafter, we fitted a full model including both the measurement and structural model (Anderson & Gerbing, 1988, Bamberg, 2006). The reliability of the dimensions in the measurement model was determined by the Cronbach's alpha and composite reliability. Convergent validity was checked by the outer loadings of the indicators and the average variance extracted (AVE). Discriminant validity was determined by the Heterotrait-Monotrait Ratio (HTMT). Potential collinearity issues were examined by the variance inflation factor (VIF). The adjusted coefficient of determination (R^2-value) was used to provide an indication of explained variance. Effect sizes included the f^2 and the Stone-Geissers value (Q^2) (see Hair et al., 2017 for detailed criteria for all indices).

5.6. Mediation effect

Fig. 2 illustrates the hypothesised mediation of the relation between work pressure and driving inattention. The mediation analysis is a multiple mediation because fatigue consists of the three dimensions physical, mental, and emotional fatigue. The same analysis will be conducted for work pressure and speeding, work pressure and driving while tired, time pressure and driving inattention, time pressure and speeding, and time pressure and driving while tired.

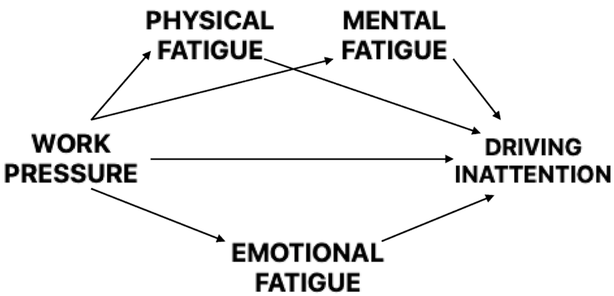

Fig. 2. Mediation example of work pressure and driving inattention.

6. Results

6.1. Sample characteristics

Table 1 shows descriptives about the sample used in this study. The 210 home healthcare workers consist of 86% women and 14% men. The largest age group was respondents of 50 years or older, followed by age groups of 40–49 years, 30–39 years and 18–29 years. A total of 46% of respondents had worked more than 10 years in the home healthcare service, 14% between 7 and 10 years, 16% 4–6 years, and 24% between 0 and 3 years. Table 2 shows that most of the respondents work fulltime. The majority of the respondents drive in both rural and city areas when driving for work-related purposes. A total of 28% solely drives in rural areas, while 21% exclusively drives in a city. Descriptives of the psychological variables used in the study are displayed in Table 2.

6.2. PLS-SEM analysis

6.2.1. Measurement model of the reflective variables

The different criteria to fit a measurement model was initially checked. The Cronbach's alpha and composite reliability values of all the constructs except the safety climate dimensions indicated good internal consistency. This also applies to the indicator loadings and AVE values of these constructs. As can be seen in Table 3, both the alpha levels and the composite reliability levels of the fatigue dimensions are satisfactory.

The dimensions of safety climate did not meet the desired thresholds for internal consistency. Upon checking the loadings of the indicators for each dimension, several indicators were below the threshold of 0.708. A reduction of the indicators for the different dimensions was therefore done on all dimensions, except management safety priority, commitment and competence which already had both good internal constancy and satisfactory loadings. To ensure content validity the reduction of indicators was based on the work of Summers et al. (2022) who did a reduction of the NOSACQ-50 by statistical analysis, expert opinions, correlations with health measures and item readability.

Management safety empowerment, management safety justice, workers' safety commitment, workers' safety priority and risk non-acceptance, safety communication, learning, and trust in co-workers' safety competence, all consist of the same indicators that Summers et al. (2022) used when reducing the dimensions of NOSACQ-50. As seen in Table 3 some of the indicators yield a slightly lower loading than the threshold of 0.708, but considering the content validity of the dimensions the indicators were not removed. None of the indicators yield loadings as low as 0.40, which is the lowest threshold loading suggested before indicators should be removed (Hair et al., 2017). Critically low loadings were detected in workers' trust in the efficacy of safety systems when applying the indicators suggested by Summers et al. (2022). When choosing the loadings that were highest for workers' trust in the efficacy of safety systems in the initial PLS-SEM analysis, and removing the weaker indicators, all included loadings were above the exclusion threshold and both internal consistency and AVE values increased. Workers' trust in the efficacy of safety systems therefore consists of one similar item to Summers et al. (2022). Regardless of this, the construct validity is considered feasible for measuring workers' trust in the efficacy of safety systems based on the chosen items and the fact that the dimension that originally consisted of seven items only lost three items. As shown in Table 3, the safety climate dimensions that eventually ended up being included in the reflective measurement model gives sufficient values on all criteria.

Results of the criteria for discriminant validity showed that all HTMT-values were satisfactory. Workers' safety commitment and the dimension of safety communication, learning, and trust in co-workers' safety competence showed a high HTMT-value (0.882). This

Table 1
Descriptive statistics of respondents (N = 210).

	n	%
Gender		
Women	181	86%
Men	29	14%
Age groups		
18–29	37	18%
30–39	42	20%
40–59	46	22%
50 years old or older	85	40%
Years of employment		
0–3	51	24%
4–6	33	16%
7–10	29	14%
More than 10 years	97	46%
Employment contract		
Fulltime	128	61%
Part time	82	39%
Area		
Rural	59	28%
City	43	21%
Both rural and city	108	51%

Table 2
Descriptive statistics of the psychological constructs.

Construct	Number of items	Mean	*SD*
Work pressure	3	3.4	0.8
Time pressure	3	3.6	1.0
Physical fatigue	6	3.0	1.0
Mental fatigue	6	3.2	1.0
Emotional fatigue	6	2.7	0.9
Management safety priority, commitment and competence	8	3.7	0.9
Management safety empowerment	4	3.4	0.0
Manage safety justice	3	3.6	0.8
Workers' safety commitment	3	3.8	0.8
Workers' safety priority and risk non-acceptance	3	3.4	1.1
Safety communication, learning, and trust in co-workers' safety competence	4	3.9	0.6
Workers' trust in the efficacy of safety systems	4	3.8	0.7
Speeding	3	2.0	1.1
Driving inattention	3	3.3	1.2
Driving while tired	2	1.8	1.0

Note. All scales scored from 1 to 5.

is considered tolerable for conceptually similar constructs (Hair et al., 2017). None of the confidence intervals for the HTMT statistics included the value of 1. Discriminant validity was therefore established for the PLS-SEM model.

6.3. *Structural model*

There were no signs of critical collinearity between any of the constructs. The highest VIF value was 3.603, which was the relation between mental fatigue and the dimensions of aberrant driving behaviour.

6.3.1. *Driving inattention*

Table 4 shows support for hypothesis 1b as work pressure had a significant positive relation to driving inattention (coefficient = 0.284, p <.001). Hypothesis 1c was also supported as mental fatigue had a significant positive relation with driving inattention (coefficient = 0.364, p <.001). Mental fatigue was the construct with the strongest relation to driving inattention. Among the demographic characteristics age had a significant negative relation to driving inattention (coefficient = −0.178, p <.01). This indicates that driving inattention decreases with age. There was no support for additional hypotheses on the relations between time pressure, physical and emotional fatigue, the different safety climate dimensions, or gender and years of employment, on driving inattention.

26% of the variance in driving inattention was explained by the exogenous constructs in this study. This explanation strength is considered a small effect. Mental fatigue had the strongest effect on driving inattention (f^2 = 0.054), followed by work pressure (f^2 = 0.053) and age (f^2 = 0.038). As all of these values are below 0.15 they are all considered small effect sizes. As the Q^2 value is above 0, the model is considered to have predictive relevance for driving inattention.

6.3.2. *Speeding*

Table 5 shows support for hypothesis 3 that workers' safety priority and risk non-acceptance would have a negative relation to speeding (coefficient = −0.283, p <.001). Hypothesis 3 also suggested that safety communication, learning, and trust in co-workers' safety competence would have a negative relation to speeding, there was however found significant positive relations between these constructs (coefficient = 0.220, p <. 05). Table 5 also shows that age did have a significant negative relation to speeding (coefficient = −0.208, p <.001). This indicates that speeding decreases with age. There was not found support for any of the hypothesised relations in hypothesis 1.

31% of the variance in speeding was explained by the exogenous constructs in this study. This explanation strength is considered medium. Workers' safety priority and risk non-acceptance had the strongest effect on speeding (f^2 = 0.069), followed by age (f^2 = 0.056) and safety communication, learning, and trust in co-workers' safety competence (f^2 = 0.034). All of these effect sizes are considered small. Q^2 value for speeding was also above 0 which indicates that the model has predictive relevance for speeding.

6.3.3. *Driving while tired*

Table 6 adds support to hypothesis 1c as physical fatigue had a significant positive relation with driving while tired (coefficient = 0.236, p <.05). Hypothesis 3 was also supported as management safety priority, commitment and competence had a significant negative effect on driving while tired (coefficient = −0.269, p <.05).

28% of the variance of driving while tired was explained by the exogenous constructs in this study. The explanation strength is considered small. Management safety priority, commitment and competence had the strongest effects on driving while tired (f^2 = 0.033), physical fatigue (f^2 = 0.033). These are considered small effect sizes. The Q^2 value for driving while tired was above 0 which indicates the modeĺs predictive relevance for this construct.

Table 3
Measurement model.

Variable	Outer loadings	95% CI LL	95% CI UL	Cronbach's alpha	Composite reliability	AVE
Physical fatigue				0.938	0.951	0.764
Indicator 1	0.836	0.783	0.875			
Indicator 2	0.817	0.750	0.866			
Indicator 3	0.907	0.876	0.931			
Indicator 4	0.897	0.867	0.920			
Indicator 5	0.913	0.882	0.935			
Indicator 6	0.869	0.826	0.900			
Mental fatigue				0.966	0.973	0.855
Indicator 1	0.915	0.882	0.938			
Indicator 2	0.897	0.862	0.924			
Indicator 3	0.943	0.922	0.958			
Indicator 4	0.938	0.916	0.954			
Indicator 5	0.950	0.931	0.964			
Indicator 6	0.906	0.866	0.932			
Emotional fatigue				0.963	0.971	0.846
Indicator 1	0.897	0.854	0.926			
Indicator 2	0.816	0.716	0.883			
Indicator 3	0.954	0.938	0.966			
Indicator 4	0.950	0.932	0.963			
Indicator 5	0.960	0.943	0.971			
Indicator 6	0.933	0.903	0.954			
Work pressure				0.824	0.895	0.740
Indicator 1	0.865	0.818	0.900			
Indicator 2	0.884	0.846	0.913			
Indicator 3	0.831	0.749	0.881			
Time pressure				0.862	0.916	0.784
Indicator 1	0.845	0.780	0.890			
Indicator 2	0.907	0.869	0.934			
Indicator 3	0.902	0.869	0.929			
Management safety priority, commitment and competence				0.905	0.923	0.601
Indicator 1	0.764	0.648	0.837			
Indicator 2	0.783	0.706	0.839			
Indicator 3	0.712	0.556	0.813			
Indicator 4	0.787	0.702	0.842			
Indicator 5	0.732	0.631	0.800			
Indicator 6	0.855	0.794	0.894			
Indicator 7	0.787	0.679	0.856			
Indicator 8	0.772	0.640	0.853			
Management safety empowerment				0.805	0.867	0.621
Indicator 1	0.840	0.751	0.890			
Indicator 2	0.696	0.477	0.816			
Indicator 3	0.799	0.669	0.873			
Indicator 4	0.809	0.677	0.886			
Management safety justice				0.753	0.836	0.632
Indicator 1	0.867	0.734	0.980			
Indicator 2	0.840	0.420	0.928			
Indicator 3	0.663	0.081	0.829			
Workers' safety commitment				0.644	0.808	0.583
Indicator 1	0.774	0.542	0.888			
Indicator 2	0.754	0.547	0.887			
Indicator 3	0.764	0.563	0.880			
Workers' safety priority and risk non-acceptance				0.612	0.779	0.548
Indicator 1	0.532	0.236	0.698			
Indicator 2	0.841	0.764	0.903			
Indicator 3	0.809	0.704	0.870			
Safety communication, learning, and trust in co-workers' safety competence				0.757	0.841	0.571
Indicator 1	0.706	0.052	0.857			
Indicator 2	0.685	0.067	0.853			
Indicator 3	0.826	0.475	0.915			
Indicator 4	0.796	0.468	0.971			
Workers' trust in the efficacy of safety systems				0.762	0.845	0.578
Indicator 1	0.777	0.582	0.927			
Indicator 2	0.727	0.495	0.852			
Indicator 3	0.816	0.683	0.892			
Indicator 4	0.716	0.321	0.879			

(*continued on next page*)

Table 3 (*continued*)

Variable	Outer loadings	95% CI		Cronbach's alpha	Composite reliability	AVE
		LL	UL			
Speeding				0.876	0.923	0.800
Indicator 1	0.878	0.793	0.922			
Indicator 2	0.870	0.788	0.914			
Indicator 3	0.935	0.912	0.953			
Driving inattention				0.856	0.910	0.773
Indicator 1	0.794	0.664	0.852			
Indicator 2	0.927	0.898	0.946			
Indicator 3	0.910	0.884	0.938			
Driving while tired				0.781	0.901	0.820
Indicator 1	0.909	0.866	0.938			
Indicator 2	0.903	0.853	0.928			

Note. CI = Bootstrap bias corrected confidence interval; LL = lower limit; UL = upper limit.

Table 4
Direct effects on driving inattention.

	Coefficients	CI 95%		f^2
		LL	UL	
Work pressure	0.284***	0.092	0.501	0.053
Time pressure	−0.048	−0.247	0.137	0.001
Management safety priority, commitment and competence	−0.184	−0.435	0.027	0.015
Management safety empowerment	0.058	−0.156	0.308	0.002
Management safety justice	0.081	−0.134	0.289	0.004
Workers' safety commitment	−0.129	−0.322	0.038	0.011
Workers' safety priority and risk non-acceptance	−0.126	−0.286	0.048	0.013
Safety communication, learning, and trust in co-workers' safety competence	0.190	0.014	0.385	0.023
Workers' trust in the efficacy of safety systems	−0.000	−0.179	0.168	0.000
Physical fatigue	−0.019	−0.209	0.164	0.000
Mental fatigue	0.364***	0.146	0.570	0.054
Emotional fatigue	−0.212	−0.430	0.025	0.019
Age	−0.178**	−0.302	−0.051	0.038
Gender	0.039	−0.084	0.166	0.002
Employment	0.010	−0.127	0.157	0.000
Driving inattention	$R^2_{adj} = 0.262$		$Q^2 = 0.193$	

Note. ** 0.01, ***0.001; CI = Bootstrap bias corrected confidence interval; LL = lower limit; UL = upper limit.

Table 5
Direct effects on speeding.

	Coefficient	CI 95%		f^2
		LL	UL	
Work pressure	0.069	−0.100	0.251	0.004
Time pressure	0.050	−0.099	0.214	0.002
Management safety priority, commitment and competence	−0.101	−0.375	0.153	0.005
Management safety empowerment	0.029	−0.132	0.213	0.001
Management safety justice	−0.044	−0.221	0.125	0.001
Workers' safety commitment	0.002	−0.209	0.210	0.000
Workers' safety priority and risk non-acceptance	−0.283***	−0.440	−0.111	0.069
Safety communication, learning, and trust in co-workers' safety competence	0.220*	0.050	0.457	0.034
Workers' trust in the efficacy of safety systems	−0.130	−0.302	0.068	0.017
Physical fatigue	0.161	−0.035	0.345	0.017
Mental fatigue	0.010	−0.188	0.214	0.000
Emotional fatigue	0.067	−0.132	0.268	0.003
Age	−0.208***	−0.323	−0.094	0.056
Gender	−0.035	−0.151	0.078	0.002
Employment	−0.034	−0.190	0.129	0.002
Speeding	$R^2_{adj} = 0.314$		$Q^2 = 0.246$	

Note. * 0.05, ***0.001; CI = Bootstrap bias corrected confidence interval; LL = lower limit; UL = upper limit.

Table 6
Direct effects on driving while tired.

	Coefficient	CI 95%		f^2
		LL	UL	
Work pressure	−0.049	−0.241	0.128	0.002
Time pressure	0.042	−0.129	0.214	0.001
Management safety priority, commitment and competence	−0.269*	−0.526	−0.033	0.033
Management safety empowerment	0.041	−0.149	0.233	0.001
Management safety justice	0.107	−0.101	0.291	0.008
Workers' safety commitment	−0.055	−0.281	0.142	0.002
Workers' safety priority and risk non-acceptance	−0.112	−0.272	0.069	0.010
Safety communication, learning, and trust in co-workers' safety competence	0.051	−0.122	0.288	0.002
Workers' trust in the efficacy of safety systems	−0.009	−0.180	0.184	0.000
Physical fatigue	0.236*	0.046	0.445	0.033
Mental fatigue	0.141	−0.103	0.379	0.008
Emotional fatigue	0.093	−0.126	0.294	0.004
Age	−0.063	−0.187	0.063	0.005
Gender	−0.071	−0.196	0.054	0.007
Employment	−0.065	−0.231	0.089	0.005
Driving while tired	$R^2_{adj} = 0.279$		$Q^2 = 0.208$	

Note. * 0.05; CI = Bootstrap bias corrected confidence interval; LL = lower limit; UL = upper limit.

6.3.4. *Constructs' predictive relevance for aberrant driving behaviour*

All the significant relations from the constructs to aberrant driving has a small q^2 value. The significant relations between management commitment to safety and safety competence and driving while tired did not deem a q^2 value above the threshold of 0.02. This indicates that even though management commitment to safety and safety competence had the strongest relation with driving while tired, the construct does not have predictive relevance for driving while tired.

6.3.5. *Direct effects of job demands on fatigue*

Both hypotheses 2a and 2b were supported by the results. Work pressure had the strongest relation with physical fatigue with a positive relation (coefficient = 0.432, $p <. 001$), followed by a positive relation between time pressure and physical fatigue (coefficient = 0.231, $p <. 001$). Time pressure had the strongest positive relation with mental fatigue (coefficient = 0.364, $p <.001$), followed by the positive relation between work pressure and mental fatigue (coefficient = 0.314, $p <. 001$). Work pressure had the strongest positive relation with emotional fatigue (coefficient = 0.361, $p <.001$), followed by a positive relation between work and time pressure (coefficient = 0.242, $p <. 001$).

The job demands explained 39% of physical fatigue, 40% of mental fatigue and 31% of emotional fatigue. These are all considered medium explanation strengths. Work pressure had the strongest relation on physical fatigue with a medium strong effect size ($f^2 = 0.158$), followed by time pressure ($f^2 = 0.044$) that had a small effect size. Time pressure had the strongest effect on mental fatigue ($f^2 = 0.112$), followed by work pressure ($f^2 = 0.087$). Both effect sizes are small. For mental fatigue the strongest effect was from work pressure ($f^2 = 0.099$), followed by time pressure ($f^2 = 0.044$). These effect sizes are also small. All Q^2 values are above 0 which indicates the model's predictive relevance for physical fatigue, mental fatigue, and emotional fatigue. The q^2 -values of job demands on the three dimensions of fatigue were all considered small, with values between 0.02 and 0.15. Of note, in line with hypothesis 2c, time pressure had a positive effect on work pressure (coefficient = 0.393, $p <. 001$).

6.4. *Mediation between time pressure and aberrant driving behaviour*

Hypothesis 4a suggested that fatigue would positively mediate the relation between time pressure and driving inattention. As shown in Table 7, this hypothesis was supported. There was no significant total effect between time pressure and driving inattention (coefficient = 0.028, $p >.05$). The total indirect effect was however significant (coefficient = 0.076, $p <.05$). The total effect is not significant because the non-significant relation between time pressure and driving inattention without the mediation-effect was negative, while the total indirect effect is positive. These opposite directions cancel each other out. Concluding that there is no

Table 7
Multiple mediation analysis of fatigue and time pressure.

	Total effect	CI 95%		Total indirect effect	CI 95%		Specific indirect effect	CI 95%	
		LL	UL		LL	UL		LL	UL
Fatigue → Inattention	0.028	−0.176	0.232	0.076*	0.008	0.164			
Mental fatigue → Inattention							0.132**	0.049	0.247
Fatigue → Speeding	0.107	−0.041	0.260	0.057	−0.006	0.135			
Fatigue → Tired	0.169*	0.008	0.335	0.128**	0.050	0.238			

Note. * 0.05, ** 0.01; CI = Bootstrap bias corrected confidence interval; LL = lower limit; UL = upper limit.

mediation would be erroneous (MacKinnon et al., 2000). In addition to the positively significant total indirect effect, there was also a positive specific indirect effect from the mediation of mental fatigue on the relation between time pressure and driving inattention (coefficient = 0.132, $p < .01$). Mental fatigue was thereby the most important fatigue dimension that mediated the relation between time pressure and driving inattention. Because time pressure did not have any significant direct relation to driving inattention, the mediation is a full mediation.

Hypothesis 4a suggested that fatigue would positively mediate the relation between time pressure and speeding. This hypothesis was not supported by the results of the analysis. Neither the total effect (coefficient = 0.107, $p > .05$) nor the total indirect effect (coefficient = 0.057, $p > .05$) was significant for the mediation of fatigue on time pressure and speeding. There were no significant specific indirect effects either. Because there were no significant direct effects between time pressure and speeding as well, it is concluded that no relationship between time pressure and speeding was found in this study.

Hypothesis 4a suggested that fatigue would positively mediate the relation between time pressure and driving while tired. The hypothesis was supported by the analysis. There were significant positive relations of both the total effect (coefficient = 0.169, $p < .05$) and the total indirect effect (coefficient = 0.128, $p < .01$). There was no significant specific indirect effect, therefore the mediation of fatigue on time pressure and driving while tired is through all the fatigue dimensions collectively. This mediation is a full mediation because time pressure did not have a significant direct relation to driving while tired.

6.5. Mediation between work pressure and aberrant driving behaviour

Hypothesis 4b suggested that that fatigue would positively mediate the relation between work pressure and aberrant driving behaviour. As Table 8 shows this hypothesis was supported from the results of the analysis.

The total effect between work pressure and driving inattention was positively significant (coefficient = 0.311, $p < .001$). There was however no significant total indirect effect (coefficient = 0.031, $p > .05$). The non-significance of the total indirect effect is caused by the specific indirect effects having opposite directions. When opposite effects cancel each other out it is important to not erroneously conclude that there is no mediation (MacKinnon et al., 2000). The only specific indirect effect that was significant for work pressure and driving inattention was the positive effect of mental fatigue (coefficient = 0.115, $p < .05$). Work pressure had a positive significant direct relation to driving inattention, and so the mediation of mental fatigue is a classified as a complementary partial mediation effect.

Hypothesis 4b also suggested that fatigue would mediate the relation between work pressure and speeding. This hypothesis was also supported as both the total effect (coefficient = 0.164, $p < .05$) and the total indirect effect (coefficient = 0.097, $p < .01$) were significant. None of the fatigue dimensions did have a significant specific indirect effect. This indicates that it is all the fatigue dimensions together that have an impact on the relation between work pressure and speeding. Because there were no direct relations between work pressure and speeding, the mediation of fatigue is a full mediation. This means that the relation between work pressure and speeding is fully explained by the mediation of fatigue.

Hypothesis 4b lastly suggested that fatigue would mediate the relation between work pressure and driving while tired. This is also supported by multiple mediation results. The total effect between work pressure and driving while tired was not significant (coefficient = 0.130, $p > .05$), but the total indirect effect was significant (coefficient = 0.177, $p < .001$). As previously explained, this is a result of opposite directions canceling each other out and concluding that there was no mediation would be erroneous (MacKinnon et al., 2000). There was found a positive significant specific indirect effect of the mediation of physical fatigue on the relation between work pressure and driving while tired (coefficient = 0.100, $p < .05$). This indicates that the mediation of fatigue on work pressure and driving while tired mainly goes through physical fatigue. Because there were no direct relations between work pressure and driving while tired, the significant positive mediation of fatigue is a full mediation.

7. Discussion

The aim of this study was to investigate the relations between work and time pressure, dimensions of work-related fatigue and safety climate with aberrant driving behaviour in the home healthcare sector. The results showed that (i) job demands among workers have a direct and indirect impact (via fatigue) on aberrant driving behaviour, (ii) taking measures to manage fatigue precursors may lead to less aberrant driving behaviour among employees in the home healthcare sector, (iii) work and time pressure are possible precursors of fatigue, and (iv) management's involvement in promoting a safe driving climate may be of importance.

Table 8
Multiple mediation analysis of fatigue and work pressure.

	Total effect	CI 95%		Total indirect effect	CI 95 %		Specific indirect effect	CI 95%	
		LL	UL		LL	UL		LL	UL
Fatigue → Inattention	0.311***	0.130	0.484	0.031	−0.050	0.131			
Mental fatigue							0.115*	0.038	0.242
Fatigue → Speeding	0.164*	0.011	0.318	0.097**	0.034	0.190			
Fatigue → Tired	0.130	−0.028	0.297	0.177***	0.101	0.285			
Physical fatigue							0.100*	0.017	0.209

Note. * 0.05, ** 0.01, ***0.001; CI = Bootstrap bias corrected confidence interval; LL = lower limit; UL = upper limit.

The results contribute to an improved understanding of the work situation of home healthcare workers by identifying precursors of their aberrant driving behaviour. Our results suggest that these derive from a combination of stressors in their primary health care work tasks and management factors in the safety climate. Increased staffing and interventions aimed at reducing turnover may have indirect impacts on improved safety, as they may lead to fewer patients per home healthcare worker and alleviate time and work pressure which, in turn, have strong links to aberrant driving behaviour. Since management factors were most strongly related to less driving while tired, promising results may be achieved by developing clear-cut resting schedules and realistic driving time estimates for the workers. There is an overall need to monitor individual workload and traffic safety practices in the home healthcare sector.

7.1. Job demands and aberrant driving behaviour

Driving inattention was the most prominent aberrant driving behaviour in this study. Not being focused while driving is a leading cause of crashes and incidents (Regan et al., 2011). Mental fatigue had the strongest relation to such driving inattention. This type of fatigue revolves around cognition and is characterised as feeling mentally tired (Frone & Tidwell, 2015). Studies using electroencephalogram (EEG) have revealed that when people are mentally fatigued it is harder to inhibit automatic shifting of attention to irrelevant stimuli (Boksen et al., 2005). This can explain why workers are thinking about work-related problems while driving instead of being fully focused on the road.

Fatigue mediated the relations between time and work pressure and driving inattention. These job demands are thereby an important part of inattentive driving among home healthcare workers, especially because they contribute to making workers mentally fatigued. In addition to the indirect effect, work pressure also had a significant positive direct effect on driving inattention. Hence, driving inattention may happen both because workers are mentally fatigued which makes it hard to fully concentrate on the driving task, and because they are experiencing pressure at work. The direct and indirect effects of work pressure indicate that not everyone will feel mentally fatigued by the job demands but may still be unfocused while driving because of the overall workload. This is possible given that people have different predispositions for how they are affected by job demands, for instance in relation to personality factors (Xanthopoulou et al., 2007; Xanthopoulou et al., 2009).

The direct relation between work pressure and driving inattention may suggest that work pressure is the most prominent issue for driving inattention. On the other hand, time pressure was the strongest predictor of mental fatigue. It is not necessarily important to differentiate which one of these stressors is the most problematic due to their strong relation. What is more is that this study clearly indicates that the driving aspect of home healthcare is strongly affected by the organisational conditions in which employees work, especially by making workers fatigued. Fatigue can come from a range of sources from both inside and outside the workplace (Williamson & Friswell, 2013), and this study indicates that some of the sources inside the workplace are related to time and work pressure. To reduce driving inattention organisations could therefore focus on coping with these job demands. The two job demands in this study also had indirect relations to both speeding and feeling tired while driving through the mediation of fatigue. This further reveals the negative impact organisational conditions can have on workers safety behaviour by affecting them physically, mentally, and emotionally.

Work pressure was the only job demand that had any relations with speeding through the mediation of fatigue. The non-significant effect of time pressure and speeding is contrary to findings in previous research (Caird & Kline, 2004). Previous findings on excessive speeding have suggested that because there is a relation between speeding and the desire to arrive on time for appointments, organisations should try to reduce time pressure (Adams-Guppy & Guppy, 1995). However, another way of handling such job demands is trying to strengthen or improve job resources, as suggested by the JD-R model. The significant effects of safety climate on speeding support the assumption that job resources may be more important for handling speeding. Nevertheless, one should not undermine that job demands, such as time pressure, may be an issue for drivers at work (Nævestad et al., 2015). As it pertains to occupational driving, it is suggested that a good safety climate, which focuses on non-acceptance of risk or perhaps stress management, may be a more effective way to address speeding or other violations.

There were indirect effects from both job demands and driving while tired through fatigue. Physical fatigue had the strongest direct and positive relation to driving while tired and also had a specific indirect effect between work pressure and driving while tired. When fatigue has been explored in relation to driving while tired by taxi drivers, researchers have suggested that focusing on decreasing the causes and effects of fatigue will make road safety interventions more effective (Menéndez et al., 2019). This is also suggested in the current study as organisations should try to find ways to manage time and work pressure in the organisation.

The importance of job demands and their relations with fatigue and aberrant driving behaviour has been studied previously (Sabir et al., 2018). The current study does however investigate this relationship in more detail by not only differentiating between different types of aberrant driving behaviour, but also between different types of fatigue. Here, mental fatigue was the most important construct for driving inattention. Physical fatigue was more important for driving while tired, and emotional fatigue did not have any direct effects on aberrant driving behaviour but might have contributed to the significance of the total indirect effect in the mediation analysis. Home healthcare workers are exposed to risks of fatigue from the nature of their job because it includes shiftwork (Winwood et al., 2006). Simply taking rest and sleep is also not possible in most situations (Williamson & Friswell, 2013). Therefore, it is suggested that focusing on reducing job demands that contribute to workers' fatigue may be promising. This study implies that such demands may be time and work pressure. Mapping out the exact demands that are challenging for a specific work group may be relevant as there can be great differences between organisations.

7.2. Safety climate and aberrant driving behaviour

Safety climate was not found to be significant for driving inattention. One explanation for the non-significant effect of safety climate is that driving is considered a task undertaken by a high degree of automaticity (Soares et al., 2021), and therefore thinking about other things than driving may happen unconsciously. On the other hand, one can argue that a good safety climate would be addressing such issues in the workforce and workers should therefore be more vigilant of staying focused while driving. Nevertheless, mental fatigue, which was the strongest predictor of driving inattention, causes difficulties with blocking out irrelevant stimuli (Boksen et al., 2005). Inattentive driving is also difficult to notice by leaders or co-workers as it occurs intrapsychologically. The current study highlights that driving inattention is among the most prominent aberrant driving behaviour among home healthcare workers.

Workers' safety priority and risk non-acceptance were associated with less speeding in the current study. In other words, when the tolerance towards violating safety rules and taking risks are low, the amount of speeding among the workers is also low. The effect of this safety climate dimension may have influenced the relations between work and time pressure and speeding. Previous studies have suggested that safety climate can moderate the effects of pressure on safety violations (Morgeson et al., 2010). The JD-R model also suggests that job resources, like safety rule communication, will influence the relations of job demands on organisational outcomes, such as safety violations (Nahrgang et al., 2011). Future research should explore this possible relation further in a moderation analysis.

Safety rules have previously been the only significant factor for traffic violations in research examining different dimensions of safety climate and work-related aberrant driving behaviour (Wills et al., 2006). This supports the findings from the current study and implies that regulations are highly important for prohibiting traffic violations in the workforce. The findings from the current study using the NOSACQ-50 also suggest that workers' general safety priority and risk non-acceptance also apply to a driving context. This dimension of safety climate may therefore influence both workers' primary and secondary tasks.

Safety communication, learning, and trust in co-workers' safety competence also had a relation with speeding. In contrast to what was expected, this effect was positive. The positive relation means that the more co-workers communicate safety, learn from each other, and trust each other's safety competence, the more speeding occurs. These surprising findings may be due to respondents answering the items of the NOSACQ-50 regarding their general safety at the workplace and not specifically regarding driving. If their general safety communication revolves around the patient, it may be that increased speeding comes from thinking that reaching the patient as soon as possible is considered good safety practice. There is, however, no consensus with this theory and the finding that workers' safety priority and risk non-acceptance lead to less speeding. Safety priority and risk non-acceptance had a stronger negative relation to speeding than the positive relation between safety communication, learning, and trust in co-workers' safety competence. Further research on the underlying dimensions of safety climate should be considered to fully understand how safety climate can influence aberrant driving behaviour.

There was a negative relation between management safety priority, commitment to safety and safety competence, and driving while tired. The relation indicates that respondents who perceive their managers to prioritise safety, as committed to safety and to have competence in safety, are experiencing less tired driving. This may indicate that management is addressing that driving while feeling tired is not a viable option and that workers are encouraged to rest or take other precautions when feeling particularly tired. Other possible explanations are that workers who perceive their managers to prioritise safety are more committed themselves to prioritise rest and the necessary precautions to avoid being tired while driving because they know that this is important for their managers. However, the q^2 value below 0.02 suggests that management safety priority, commitment to safety, and safety competence do not have predictive relevance for driving while tired, making this finding of a significant relation uncertain.

Stronger and more significant relations with safety climate on the management level and aberrant driving behaviour were expected based on previous research (Wills et al., 2006). Co-workers' aspects of safety were the only dimensions that significantly predicted speeding, indicating that workers may communicate driving safety more than leadership is communicating the driving task of the job. This presumption is supported by qualitative research which found that many of the organisations ($N = 83$) did not have a clear understanding of who was responsible or accountable for road safety management (Warmerdam et al., 2017). This contradiction was supposedly caused by the fact that organisations viewed driving as a secondary job task. The authors further argued that a nurse was considered a healthcare professional and not an occupational driver. Another explanation for why management did not appear as very important in the current study could be that universal measures of safety climate tend to be somewhat weaker predictors of safety behaviours and outcomes than organisational specific measures (Jiang et al., 2019).

7.3. Policy implications

This study shows that home healthcare workers are exposed to job demands that may lead to fatigue, which in turn could increase driving inattention and driving while tired. Driving inattention was the most prominent aberrant driving behaviour among the respondents in this study. It is therefore suggested that efforts aimed at reducing inattentive driving could include measures reducing the sources of mental fatigue. Qualitative research has shown that fatigue management has not been commonly implemented in light vehicle fleets and that employees had to address fatigue issues together with their closest manager for measures to be undertaken (Warmerdam et al., 2017). There could be several factors that inhibit workers in approaching management with such personal health-related issues. As such, preventing fatigue among workers in the first place should be prioritised. The current study suggests that both work and time pressure are potential sources of fatigue among home healthcare workers. The reasons for why workers are experiencing work and time pressure may be connected to the lack of personnel in the Norwegian home healthcare sector (Gautun, 2021). Understaffing can cause chronic fatigue because it affects workers' sleep, time on duty, overtime, as well as unpredictability in driving routes and working schedules (Lerman et al., 2012). Development of a neighborhood-centric provision of services to this group could potentially reduce time and work pressure as well as fatigue. Furthermore, increasing the workforce or reducing the number of patients assigned to each home healthcare worker could lead to decreased work pressure and ultimately a reduction in driving risks. The authorities should develop schemes that attract more people to the health-related educations and make it more attractive to work in the sector.

Further, an effective method for minimizing worker fatigue is through the development of a fatigue risk management system (FRMS) (Lerman et al., 2012). The key is to identify workplace risks relating to fatigue. An extensive FRMS is costly and demands a shared responsibility of the FRMS in the organization and smaller organizations would therefore benefit more from using a simpler or more limited version of FRMS (Sprajcer et al., 2022). This may be more appropriate for home healthcare organisations with fewer staff members.

In addition to managing fatigue and its causes, driving behaviour may also be improved by focusing on enhancing organizational safety climate. In this study, safety climate was most important for speeding. Intervention programmes that focus on group discussions have previously shown to decrease work-related traffic accidents (Salminen, 2008). In said study, a sample discussed issues such as risks and problems in work-related driving and potential solutions to these issues. A similar approach may be fruitful in the home healthcare sector given that co-worker safety climate already seems to be an important inhibitor of speeding. Making room for such discussions may therefore be important for further improvement of home healthcare workers driving behaviour.

7.4. Strengths and limitations

The current study advances the literature by investigating road traffic safety in the home healthcare sector. To the best of our knowledge there are no similar studies on this working population dwelling into detail of their aberrant driving and its precursors. The study is also a contribution to safety research on light vehicle drivers and research in organisations where driving is considered a secondary task. Considering different types of aberrant driving behaviour, in addition to several aspects of fatigue, safety climate, and job demands, are of great value for further understanding the relations between organisational factors and safety related outcomes. The results can also be generalised to similar workgroups that drive as part of their job. In addition, the study is beneficial as it shows that some aspects of the general safety climate can affect aberrant driving behaviour, but that aberrant driving behaviour, especially on a manager level, should be specifically addressed in the safety climate.

Even though this study has several strenghts, there are also some limitations to this research. Firstly, the research design makes it impossible to estimate any causal relationships between the study constructs. Secondly, there might be bias in the survey due to sensitive items. Aberrant driving behaviour items may, for instance, be considered sensitive because they might raise fears about repercussions if the information is given, and they may also trigger social desirability (Tourangeau & Yan, 2007). However, web-based self-administered questionnaires tend to yield less socially desirable responses compared to other approaches like phone interviewing (Kreuter et al., 2008). Research on self-reported aberrant driving behaviour has also found that these items only produce small biases (Lajunen & Summala, 2003). Thirdly, the sample size was relatively small. It is noted that home healthcare workers constitute a relatively small sub-population in the Norwegian health sector and are often challenging to involve in research due to their busy working schedules. As such, the study may have been somewhat underpowered, and the detected relations may be underestimated. Fourthly, no items regarding phone use while driving were included in the questionnaire. Talking or texting on the phone is an increasingly common type of driving distraction (Hill et al., 2020), which causes decreased driving performance (Phuksuksakul et al., 2021). It could be important to investigate whether this type of driving distraction is problematic among home healthcare workers. It might also be considered a limitation that driving errors were not included in the analysis. There was an attempt to include driving errors, but the construct did not fulfill the psychometric requirements. Fifthly, one could argue that some of the measures included in the present study are rather dated as substantial differences have taken place in the transport system since 2010. However, we still consider the ODBQ (and the DBQ) as a relevant concurrent measure of aberrant driving behaviour. Already in 1993 (West et al., 1993) demonstrated a strong positive correlation between a very premature self-reported driving behaviour inventory and observed driving behaviour. This correlation was re-demonstrated using the extensively more tested DBQ in a very recent study of reported and observed speeding (Hill et al., 2023). Most items in the ODBQ scale are related to speeding, inattention, and driving while fatigued/tired. These three behavioural types continue to be among the most important in accident causation (Papantoniou et al., 2022; Sundfør et al., 2019; Pervez et al., 2022). This is also reflected by the fact that most cutting-edge traffic safety interventions still focus on addressing speeding, inattentive driving, and driving while tired. Finally, it could be argued that the measurement instruments should have been designed according to the specific characteristics of home healthcare workers. We appreciate the complexity of developing specific measures for different sub-groups of workers, as this could result in a proliferation of instruments that are strictly limited. Also, the measures used in the current study have demonstrated strong psychometric properties and criterion validity across a multitude of work settings (e.g. de Winter et al., 2015; Menendez et al., 2022; Yilmaz et al., 2022; Yousefi et al., 2016; Schüler & Matuszczyk, 2019; Moda et al., 2021).

8. Conclusion

This study investigated how job demands and resources related to aberrant driving behaviour among home healthcare workers. The analysis supported the idea that time and work pressure are positively related to aberrant driving, although this relation was mostly by mediation through fatigue. Driving inattention and feeling tired while driving were the aberrant driving behaviour with the strongest relations to these demands and the fatigue dimensions. This indicates that home healthcare workers are affected by their high job demands, which in turn make workers unfocused and tired while driving. Measures should be taken to reduce job demands that home healthcare workers are experiencing as it is affecting both their health and safety at work.

Higher age and the safety climate factor of safety priority and risk non-acceptance were related to less speeding. The safety climate factor of safety communication, learning, and trust in co-workers' safety competence was related to more speeding. Further research could dwell into how different aspects of safety climate affect aberrant driving behaviour among home healthcare workers. The safety climate among home healthcare workers was considered overall good in this Norwegian setting, but it would be beneficial for organisations to further emphasise road traffic safety. This will especially apply to management, as it appears that workers are more affected by co-workers' safety communication than management safety communication regarding road traffic safety.

CRediT authorship contribution statement

Trond Nordfjærn: Writing – review & editing, Conceptualization, Methodology, Supervision, Investigation. **Amanda Nordgård:** Writing – original draft, Data curation, Formal analysis. **Milad Mehdizadeh:** Writing – review & editing.

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.

Data availability

Data will be made available on request.

Appendix A

The basic equations for the PLS-SEM model are as follows:

Measurement Model Equations:

a. The indicator equation for the observed variables:

$X = \lambda x\ \xi + \varepsilon$

where X is the observed variable, λx is the factor loading, ξ is the latent variable, and ε is the error term.

b. The indicator equation for the reflective latent variables:

$\xi = \lambda\xi\ \eta + \delta$

where ξ is the latent variable, $\lambda\xi$ is the factor loading, η is the reflective latent variable, and δ is the error term.

c. The indicator equation for the formative latent variables:

$\eta = \gamma\eta\ X + \zeta$

where η is the formative latent variable, $\gamma\eta$ is the weighting factor, X is the observed variable, and ζ is the error term.

Structural Model Equation:

$\xi = \beta\eta\ \eta + \zeta$.

where ξ is the endogenous latent variable, $\beta\eta$ is the path coefficient, η is the exogenous latent variable, and ζ is the error term.

Overall Model Equation:

$X = \lambda x\ \beta\eta\ \eta + \varepsilon$

where X is the observed variable, λx is the factor loading, $\beta\eta$ is the path coefficient, η is the exogenous latent variable, and ε is the error term.

These equations are used to estimate the parameters of the PLS-SEM model using partial least squares regression.

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