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BMJ Open A new ranking index to identify the work-related psychosocial factors most impacting mental health: a cross-sectional study

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ABSTRACT

Objectives In modern professional life, mental health prevention and promotion have become a major challenge for decision-makers. Devising appropriate actions requires better understanding the role played by each work-related psychosocial factor (WPSF). The objective of this study was to present a relevant tool to hierarchise WPSFs that jointly takes into account their *importance* (impact on mental health) and their *prevalence* (the proportion of the population exposed to WPSF).

Design A cross-sectional study was conducted in March 2018 among 3200 French workers which are representative of the French working population.

Setting France.

Participants Individuals aged 18–80 years who declared currently having a job (even a part-time job) whatever their occupation or status (employee or self-employed) were eligible. We excluded students, unemployed individuals, housewives/husbands and retired people. The mental health level was assessed using the General Health Questionnaire-28 and 44 items were gathered from theoretical models of WPSFs. We assessed two distinct multivariate methods for calculating WPSF importance: (1) weifila (weighted first last) method in a linear regression context and (2) random forests in a non-linear context. Both methods were adjusted on individual, health and job characteristics.

Results The WPSF rankings obtained with the two methods to calculate importance are strongly consistent with each other (correlation coefficient=0.88). We highlighted nine WPSFs that are ranked high by both methods. In particular, irrespective of the chosen method, lack of communication, lack of social and hierarchy support and personal–professional life imbalance, emotional demands at work and dissatisfaction with the compensation received came out as top-ranking WPSFs.

Conclusions A total of nine WPSFs were identified as key for decision-making. The easy-to-use tools we propose can help decision-makers identify priority WPSFs and design effective strategies to promote mental health in the workplace.

INTRODUCTION

Because mental health disorders are both a major public health and economic issues,

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ To the best of our knowledge, this is the first study considering jointly the impact of work-related psychosocial factor (WPSF) (using multivariate approaches) and their proportion of exposure in the workplace in order to rank them.
- ⇒ Our method (and results) may be an effective tool for decision-makers to devise appropriate prevention programmes against mental disorders in the workplace.
- ⇒ The participants were representative of the French working population based on sex, age, occupation and residence locality.
- ⇒ The study outcome (General Health Questionnaire-28) and WPSFs were self-reported and this type of data collection could potentially increase the proportion of misclassification.
- ⇒ The cross-sectional nature of the data limits the interpretability of our results, and hence, doing prospective studies is needed to fully explore the causal relationship between mental health and the WPSFs identified, in addition to the results already obtained.

promoting good mental health and well-being in the workplace has become an increasingly important challenge.^{1,2} A broad range of work-related psychosocial factors (WPSFs) have been documented as having an impact on mental health.^{3–5} However, decision-makers lack pertinent methodological tools to help them identify key WPSFs on which they may act to improve mental health among employees. Indeed, most published studies attempting to hierarchise WPSFs have focused on their *importance* only, that is, on the strength of their association with mental health.^{6–9} However, the exposure prevalence to each WPSF is also important to consider. Indeed, a prevention strategy focused on WPSFs strongly influencing mental health, but only affecting a small fraction of employees, could have no significant benefit at the level of a company.



One approach to deal with this issue is to graphically identify WPSFs requiring priority action and those to maintain for future prevention plans, by plotting WPSF importance (Y-axis) against WPSF exposure prevalence (X-axis). This method is simple and easy to use for decision-making. Another approach, proposed by Cooper,¹⁰ is to compute a ranking index (RI), which is the product of the importance and the mean value of WPSFs. However, the statistical relevance of the Cooper index has recently been criticised by Hocine *et al*,¹¹ mainly because of its univariate estimation of the importance of predictors. Indeed, importance quantification should be adjusted over potential cofactors. It should also account for the strong collinearity between WPSFs.

Here, we propose a new adjusted RI to hierarchise WPSFs, as well as a graphical tool, to visually identify WPSFs requiring priority action to promote mental health in the workplace. The usefulness of this approach is illustrated using recent data from a cross-sectional study conducted in 2018.¹² In this article, we first briefly describe the study data. Second, we describe the developed WPSF RI using an adapted Cooper-like index that includes multivariate assessment of the WPSF's importance instead of the univariate 'consequence' originally used by Cooper. Third, we use this index to hierarchise WPSF study previously and illustrate our results graphically. We compare two different methods to assess the importance and show that our main results do not change. Finally, an alternative approach based on the population attributable fraction (PAF) is presented. These results may help identify WPSFs that decision-makers should prioritise for action.

METHODS

Study population

The present work was based on the analysis of a cross-sectional study conducted in March 2018 on a sample of 3200 workers, representative of the French working population,¹² the 'Baromètre Travail et Santé Psychique' survey. Representativeness was achieved by using both quota sampling for sex, age, occupation and residence locality,¹² and the rim weighting method (raking).¹³ Workers were recruited in the 'Ipsos Access Panel' and were invited by email to participate in the study. The active population represented in the database was composed of both employees (87.6%, n=2803) and self-employed individuals (12.4%, n=397). For this paper, we focused on employees only.

Measurement tools

Mental health level was measured using a validated French version of the General Health Questionnaire (GHQ-28).¹⁴ This questionnaire includes 28 4-point Likert scale items (from 0 to 3). A global mental health score (GHQ-28 score) was calculated as the sum of the 28 answers, thus ranging from 0 to 84 (from very good to very bad mental health).

A 44-item questionnaire¹² was used to measure work-related WPSFs based on an integrative view of several conceptual models on WPSFs and their effects (Karasek,³ Siegrist,⁴ Greenberg⁵ and Harvey *et al*¹⁵). All these models describe the individual perception of the work environment. See Chevance *et al*,¹² the seminal paper of this study, for more details on the development of the WPSFs. Participants provided their degree of agreement with each of the 44 items on a 4-point Likert scale: 'fully agree', 'agree', 'disagree' and 'fully disagree'. To facilitate the interpretation of each WPSF, the initial 4-point Likert scale was binarised into 1 (affected) for 'fully agree' and 'agree' and 0 (unaffected) for 'disagree' and 'fully disagree'. The first two columns in [table 1](#) show a detailed list of the 44 assessed WPSFs in the study.

Data on individual, health and job characteristics were also collected: gender (men vs women), age in years (18–24, 25–34, 35–44, 45–54 and 55 and more), work duration per week (less than 50 hours vs 50 hours and more), weekend work (yes vs no), night work (yes vs no), staggered work hours (yes vs no), commuting duration (less than 1 hour vs 1 hour and more), previous unemployment experience (already known vs never known) and chronic medical conditions (yes vs no). Data collected are available in online supplemental file 2.

Ranking methodology

First of all, in a purpose of dimension reduction, we performed a feature selection using clustering of all WPSFs. The agglomerative hierarchical clustering algorithm proposed in the R package *ClustOfVar* was used and a bootstrap approach was performed to determine the appropriate number of clusters.¹⁶ WPSFs that were strongly correlated with each other were allocated to the same cluster. For each cluster, a single variable was selected based on its pertinence as a potential action driver.

In order to propose a ranking of WPSFs, we first assessed the prevalence and importance of each selected WPSF, and then computed an RI based on these indicators. All statistical analyses were conducted using R ×64, V.3.6.0 of 2019-04-26 (R Foundation for Statistical Computing).

Prevalence measurement

For each WPSF selected, the prevalence in the workplace was measured. To describe the impact of exposure to each WPSF, the average GHQ-28 score was compared between affected and unaffected employees using a two-sided Student's t-test with Holm-Bonferroni correction. P value <0.05 was considered statistically significant.

Importance calculation

For each WPSF selected, importance was calculated as an adjusted strength of the association between the mental health outcome and this specific WPSF. This was done using two different multivariate methods to explain the mental health-level outcome defined by the GHQ-28 score from the selected WPSFs and the nine covariates:

Table 1 Descriptive analysis of WPSFs in the study population

| WPSF | | Prevalence (% affected) | GHQ-28 score mean (SD) | | P value* |
|------|--|----------------------------|------------------------|-------------|----------|
| No | Description | | Affected | Unaffected | |
| 1 | My job consists of monotonous and repetitive tasks. | 38 | 20.7 (16.0) | 17.5 (12.5) | <0.001 |
| 2 | In my job, I must respect rigid procedures and I am closely supervised. | 61 | 19.3 (14.6) | 17.8 (13.0) | 0.03 |
| 3 | <i>Inverse of:</i> Company performance appraisals and promotions are fairly done. | 51 | 20.8 (12.2) | 16.6 (12.2) | <0.001 |
| 4 | <i>Inverse of:</i> I feel like I can participate in my company's decision-making process. | 49 | 20.5 (12.2) | 17.5 (12.2) | <0.001 |
| 5 | <i>Inverse of:</i> The communication and information exchange process within my company is satisfactory. | 43 | 22.1 (11.7) | 16.1 (11.7) | <0.001 |
| 6 | <i>Inverse of:</i> My work environment is pleasant. | 24 | 24.3 (12.2) | 16.9 (12.2) | <0.001 |
| 7 | I don't exactly know what corporate function is expected from me. | 24 | 20.9 (16.8) | 18.0 (13.0) | 0.001 |
| 8 | I handle an enormous amount of complex information. | 60 | 19.4 (14.6) | 17.7 (13.1) | 0.02 |
| 9 | <i>Inverse of:</i> I have no problem handling my professional and private responsibilities. | 15 | 26.7 (12.3) | 17.3 (12.3) | <0.001 |
| 10 | I am unable to plan what my job will be in 2 years. | 64 | 19.7 (14.7) | 17.0 (12.5) | <0.001 |
| 11 | I need more time to do my job. | 50 | 20.1 (15.3) | 17.4 (12.5) | <0.001 |
| 12 | I often have to deal with rude and/or aggressive people. | 42 | 21.0 (15.9) | 17.1 (12.3) | <0.001 |
| 13 | <i>Inverse of:</i> In my job, I feel valued and recognised. | 30 | 23.5 (11.9) | 16.7 (11.9) | <0.001 |
| 14 | When doing certain tasks in my job I often feel like I don't have enough training. | 41 | 20.2 (15.7) | 17.7 (12.6) | <0.001 |
| 15 | My work atmosphere is unpleasant. | 33 | 22.4 (16.9) | 16.9 (12.0) | <0.001 |
| 16 | <i>Inverse of:</i> My hierarchy supports and helps me when needed. | 37 | 21.6 (12.4) | 17.1 (12.4) | <0.001 |
| 17 | I spend a lot of time commuting for my job. | 29 | 19.0 (15.3) | 18.6 (13.5) | 0.9 |
| 18 | <i>Inverse of:</i> I know that I can depend on the people I work with. | 27 | 24.2 (12.0) | 16.7 (12.0) | <0.001 |
| 19 | In my job, making a mistake could have serious consequences. | 62 | 19.3 (14.8) | 17.8 (12.6) | 0.03 |
| 20 | <i>Inverse of:</i> My job makes me feel useful and gives me self-esteem. | 22 | 24.5 (12.4) | 17.1 (12.4) | <0.001 |
| 21 | <i>Inverse of:</i> I have the necessary resources and technical means to correctly do my job. | 28 | 22.9 (12.6) | 17.1 (12.6) | <0.001 |
| 22 | <i>Inverse of:</i> I have a good idea of my career prospects within the company. | 48 | 21.3 (12.2) | 16.4 (12.2) | <0.001 |
| 23 | My job requires long periods of intense concentration. | 64 | 19.2 (14.6) | 17.8 (12.9) | 0.06 |
| 24 | My objectives are difficult to reach. | 32 | 21.3 (16.9) | 17.5 (12.3) | <0.001 |
| 25 | My work schedule is not flexible. | 37 | 20.4 (15.7) | 17.7 (12.8) | <0.001 |
| 26 | <i>Inverse of:</i> My work relationships are a source of satisfaction. | 21 | 24.0 (12.4) | 17.3 (12.4) | <0.001 |
| 27 | The job I do requires that I constantly adapt to new things. | 75 | 18.9 (14.2) | 18.1 (13.5) | 0.8 |
| 28 | I work in a noisy and hectic environment. | 49 | 20.0 (15.3) | 17.5 (12.6) | <0.001 |
| 29 | Someone or some people at my workplace enjoy making me suffer. | 22 | 22.6 (18.2) | 17.6 (12.4) | <0.001 |
| 30 | <i>Inverse of:</i> I'm in charge of my work schedule and my breaks. | 30 | 21.9 (12.8) | 17.3 (12.8) | <0.001 |
| 31 | I do not identify with my employer's corporate values. | 34 | 21.2 (16.4) | 17.5 (12.5) | <0.001 |
| 32 | <i>Inverse of:</i> I get along well with my hierarchy. | 19 | 24.0 (12.8) | 17.5 (12.8) | <0.001 |
| 33 | <i>Inverse of:</i> I feel morally supported in my job. | 37 | 22.2 (12.0) | 16.6 (12.0) | <0.001 |

Continued

**Table 1** Continued

| WPSF | | Prevalence (% affected) | GHQ-28 score mean (SD) | | P value* |
|------|---|----------------------------|------------------------|-------------|----------|
| No | Description | | Affected | Unaffected | |
| 34 | I am often interrupted during my work. | 57 | 19.9 (15.1) | 17.2 (12.3) | <0.001 |
| 35 | My job often puts me in contact with clients/users. | 71 | 18.7 (14.1) | 18.7 (13.8) | 0.9 |
| 36 | My job puts me into trying emotional situations. | 43 | 21.4 (16.2) | 16.7 (11.7) | <0.001 |
| 37 | <i>Inverse of:</i> I'm proud of what I do in my job. | 24 | 23.2 (12.7) | 17.3 (12.7) | <0.001 |
| 38 | Sometimes I feel afraid when I do my job. | 28 | 23.0 (18.0) | 17.0 (11.7) | <0.001 |
| 39 | <i>Inverse of:</i> I am proud of my company. | 39 | 21.5 (12.4) | 17.0 (12.4) | <0.001 |
| 40 | I feel like I often have to rush my work due to external constraints. | 34 | 21.3 (16.8) | 17.4 (12.1) | <0.001 |
| 41 | In my job I am faced with constant change. | 53 | 20.3 (15.2) | 17.0 (12.4) | <0.001 |
| 42 | <i>Inverse of:</i> I have a lot of leeway in my job. | 45 | 21.2 (12.5) | 16.7 (12.5) | <0.001 |
| 43 | I am fearful for my professional future. | 42 | 21.4 (16.5) | 16.8 (11.5) | <0.001 |
| 44 | <i>Inverse of:</i> I am satisfied with the compensation I receive for my job. | 52 | 20.8 (12.4) | 16.4 (12.4) | <0.001 |

The proportion of 2803 employees affected by each WPSF is provided, as well as the mean and SD of the GHQ-28 score among affected and unaffected populations.

*Statistical significance calculated using two-sided Student's t-test and adjusted using Holm-Bonferroni correction. GHQ-28, General Health Questionnaire; WPSF, work-related psychosocial factor.

the weifila approach, which is based on variance decomposition in a linear regression context,¹⁷ and a permutation random forest approach in a non-linear context.¹⁸ Both methods are described in more detail in online supplemental appendices A and B. To ensure better comparability between the two methods, WPSF importance was normalised to 100% (by the sum of selected WPSF importance values) in both.

WPSF ranking index

For each WPSF, we computed the RI as follows:

$$\text{RI} = \text{importance} \times \text{prevalence}$$

Priority action should be given to WPSFs with a highest RI value.

The estimations of RIs obtained using the weifila and random forest methods were compared to assess the stability of our WPSF classification using Spearman correlation.¹⁹ Finally, we identified key WPSFs based on a synthesis of our results.

An alternative epidemiological approach

Assuming a causal relationship between exposure to WPSFs and mental health, PAFs could be computed. PAF is a commonly used epidemiological indicator, first proposed by Levin in 1953.²⁰ It estimates the proportion of cases in a population that would not have occurred if there had been no exposure, accounting for both the strength of exposure-disease association and the prevalence (Pe). It could therefore represent an interesting alternative to the RI we proposed for a ranking focus.

To investigate the potential of using PAFs, we modelled the impact of WPSFs on the binary outcome 'GHQ-28 score ≥ 24 ' (a commonly used threshold in

psychiatry¹⁴) using logistic regression adjusted for the nine confounders. A variable selection was performed using regression subset selection in R applying the *fastbw* function²¹ based on Akaike information criterion.²² Then, we computed ORs of high GHQ scores associated with each WPSF included in the final model obtained. The PAF of a given WPSF was then computed as: $\text{PAF} = (\text{Pe} (\text{OR} - 1)) / (1 + \text{Pe} (\text{OR} - 1))$.

Patient and public involvement

This research was done without patient and public involvement. However, we disseminated the results of this analysis through public conferences.

RESULTS

Data description

Table 1 provides the prevalence of each WPSF and compares GHQ-28 scores between affected and unaffected employees. GHQ-28 scores were significantly higher in affected populations for most WPSFs. Only four WPSFs (WPSFs 17, 23, 27 and 35, corresponding to long commuting durations, need for intense concentration, need to adapt and frequent contacts with clients/users) presented non-significant differences in GHQ-28 score mean between affected and unaffected employees. Table 2 provides the GHQ-28 mean for all participants as well as a description of all individual covariates and their GHQ-28 means. For instance, the average GHQ-28 score was significantly higher for female than for male (20.4 vs 17.0, $p < 0.001$). The mean observed value of the GHQ-28 score for all participants is equal to 18.32 (SD=13.9). Due

Table 2 Descriptive analysis of individual covariates in the study population

| Individual covariates | % | GHQ-28 score mean (SD) | P value* |
|-------------------------------------|----|------------------------|----------|
| All participants | | 18.32 (13.9) | |
| Gender | | | <0.001 |
| Male | 50 | 17.0 (13.2) | |
| Female | 50 | 20.4 (14.6) | |
| Age group (years)† | | | <0.005 |
| 18–24 | 9 | 20.7 (12.6) | |
| 25–34 | 24 | 18.8 (14.2) | |
| 35–44 | 27 | 19.3 (14.8) | |
| 45–54 | 27 | 18.1 (13.8) | |
| 55 and more | 12 | 16.8 (12.5) | |
| Work duration per week (hours) | | | 0.01 |
| <50 | 94 | 18.5 (13.8) | |
| 50+ | 6 | 22.4 (16.3) | |
| Working on weekend | | | 0.03 |
| Yes | 61 | 19.3 (14.6) | |
| No | 39 | 17.8 (13.1) | |
| Working at night | | | 0.8 |
| Yes | 26 | 19.2 (14.5) | |
| No | 74 | 18.5 (13.9) | |
| Working in staggered hours | | | <0.001 |
| Yes | 59 | 19.5 (14.7) | |
| No | 41 | 17.6 (12.9) | |
| Commuting duration (hours) | | | 0.04 |
| <1 | 73 | 18.3 (13.6) | |
| 1+ | 27 | 19.9 (15.0) | |
| Previous experience of unemployment | | | 0.1 |
| Already known | 51 | 19.3 (14.2) | |
| Never known | 49 | 18.1 (13.8) | |
| Chronic medical conditions | | | <0.001 |
| Yes | 24 | 13.5 (16.4) | |
| No | 76 | 17.2 (12.7) | |

For each modality of the covariates, proportions among 2803 employees are provided, as well as the mean and SD of the GHQ-28 score.

*Statistical significance was calculated using two-sided Student's t-test or analysis of variance (ANOVA), and adjusted using Holm-Bonferroni correction.

†Test is performed with a one-way ANOVA.

GHQ-28, General Health Questionnaire.

to the large sample available, the normal distribution is assumed for all test statistics.

WPSF selection and ranking

The results of the feature selection (hierarchical clustering) applied to reduce the dimension are provided in figure 1. The results from the bootstrap approach used

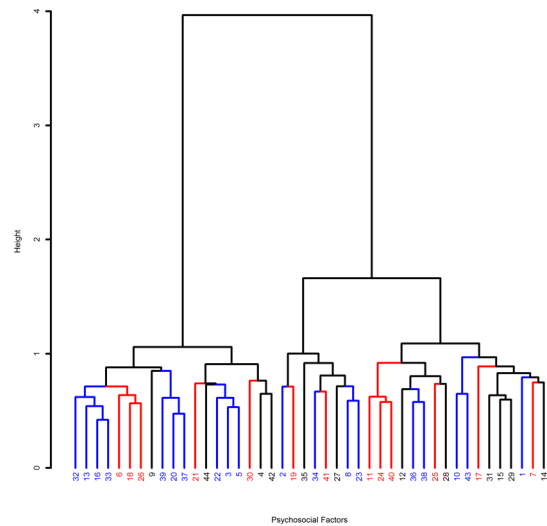


Figure 1 Dendrogram of the hierarchical clustering of the 44 work-related psychosocial factors. Each colour represents one cluster according to the bootstrap approach.

to determine the stability of the partitions and therefore the number of clusters to consider are provided in online supplemental appendix C. Twenty-seven clusters were identified for the 44 WPSFs (online supplemental appendix C) and each colour in figure 1 represents one cluster. The chosen WPSFs for each cluster were: WPSF 16, 18, 9, 37, 21, 44, 5, 30, 4, 2, 19, 35, 34, 41, 27, 8, 24, 12, 36, 25, 28, 43, 17, 29, 1, 7, 14.

The importance of the 27 WPSFs according to weifila and random forest approaches, as well as their prevalence and the resulting ranking indices, is provided in online supplemental appendix D. The weifila model explained 18.4% of the variation of the GHQ-28 score ($R^2=0.184$), whereas the random forest approach explained 31.5% of this variation ($R^2=0.315$).

The two ranking results were strongly consistent (correlation coefficient=0.88; $p<0.001$), as illustrated on the scatter plot given in online supplemental appendix E. Table 3 lists the 10 WPSFs with the highest RIs obtained with the weifila and random forest approaches.

A total of nine WPSFs were found in common and thus identified as key for decision-making: WPSF 5 (unsatisfactory communication and information at work), WPSF 9 (problems handling professional and private responsibilities), WPSF 18 (inability to depend on work collaborators), WPSF 36 (emotional situations at work), WPSF 44 (dissatisfaction with the compensation received for the job), WPSF 43 (being afraid with the professional future), WPSF 16 (lack of support and help from the hierarchy), WPSF 21 (lack of necessary resources and technical means to correctly do the job), WPSF 37 (unproud of the job).

These nine WPSFs can also be visually identified from the RI isocurves plotted in figure 2 (for the weifila-based importance).

Table 4 summarises the final ranking of WPSFs obtained using the RI. For each WPSF, the corresponding

Table 3 List of the 10 priority WPSFs identified using (A) the weifila approach and (B) the random forest approach to assess their importance on the GHQ-28 score

| WPSF No | Prevalence (%) | Importance (%) | RI | Ranking |
|----------|----------------|----------------|-------|---------|
| A | | | | |
| 5 | 43 | 8.6 | 372.1 | 1 |
| 18 | 27 | 13.5 | 362.5 | 2 |
| 9 | 15 | 17.5 | 262.1 | 3 |
| 36 | 43 | 5.6 | 237.3 | 4 |
| 44 | 52 | 4.1 | 215.8 | 5 |
| 43 | 42 | 4.5 | 191.1 | 6 |
| 21 | 28 | 5.7 | 162.3 | 7 |
| 16 | 37 | 4.1 | 150 | 8 |
| 37 | 24 | 6 | 143.5 | 9 |
| 4* | 49 | 2.6 | 126.2 | 10 |
| B | | | | |
| 5 | 43 | 12.1 | 522.3 | 1 |
| 18 | 27 | 16.3 | 436.9 | 2 |
| 9 | 15 | 26.5 | 396.7 | 3 |
| 36 | 43 | 6.8 | 288.8 | 4 |
| 43 | 42 | 5.6 | 235.4 | 5 |
| 44 | 52 | 3.2 | 169.6 | 6 |
| 29* | 22 | 5.2 | 113.3 | 7 |
| 21 | 28 | 3.4 | 95.3 | 8 |
| 37 | 24 | 3.2 | 75.6 | 9 |
| 16 | 37 | 2 | 74.1 | 10 |

For each WPSF, the computed prevalence, importance and RI are provided. WPSFs are ranked according to their RI. Description of the WPSF items is available in [table 1](#).
*WPSFs 4 and 29 are *not* common for both approaches.
GHQ-28, General Health Questionnaire; RI, ranking index; WPSF, work-related psychosocial factor.

correlated WPSFs in the same cluster are listed and a global descriptive name is provided for the cluster.

An alternative epidemiological approach: PAF

Table 5 provides the results of the adjusted logistic regression, as well as the prevalence and PAF of each WPSF retained in the final model.

Among the nine WPSFs retained, seven were found in common with the key WPSFs identified according to the RI method (WPSFs 36, 43, 44, 18, 5, 9 and 21), suggesting that PAFs could indeed prove a sustainable alternative to RIs.

DISCUSSION

Throughout our study, the objective was to offer a relevant indicator to prioritise work-related WPSFs, with a specific application in mental health. Due to the inadequacy of the importance of WPSFs as a sole basis for

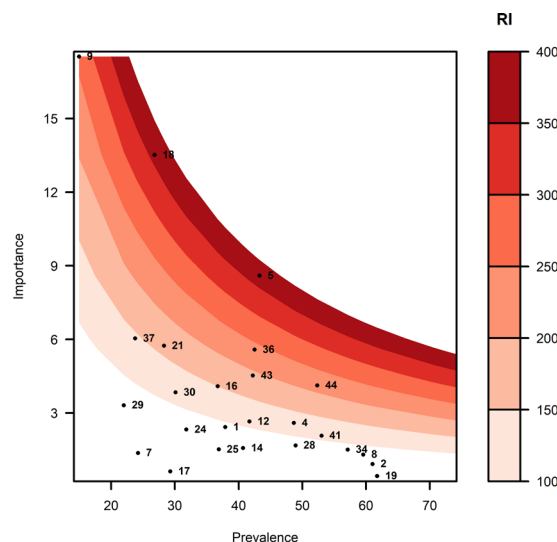


Figure 2 Importance-prevalence plot for the 27 work-related psychosocial factors, with the importance obtained with the weifila approach. Isocurves are provided for the ranking index (RI) values.

decision-making, we also accounted for employee prevalence in our prioritisation approach.

Main findings

We identified nine WPSFs that need priority actions to prevent mental health disorders at the workplace. Lack of communication (WPSF 5), lack of social and hierarchy support within the company (WPSFs 18, 16), as well as imbalance between private and personal responsibilities (WPSF 9) were found to be the most important key WPSFs that decision-makers should concentrate on to improve the mental health of employees. Furthermore, being exposed to emotional situations at work (WPSF 36), dissatisfaction with the compensation received for the job (WPSF 44), being afraid with the professional future (WPSF 43), lack of necessary resources and technical means to correctly do the job (WPSF 21) and unproud of the job (WPSF 37) were also found important to consider to prevent mental disorders at work. However, the choice of the appropriate WPSF for the prevention plan is made by the decision-maker. In addition to the obtained rank using the RI, the decision-maker may choose among WPSFs in the same cluster ([figure 1](#) and [table 4](#)) the WPSF optimising other elements such as the prevention action cost, the social acceptability and the feasibility at workplace.

Assuming a causal relationship between exposure to WPSFs and mental health, PAFs were computed and seven WPSFs were found in common with the key WPSFs identified according to the RI method (WPSFs 36, 43, 44, 18, 5, 9 and 21). Because of its simplicity and ease of interpretation (eg, PAF=20% for WPSF 36 means that 20% of potential cases of mental disorders among employees could be attributable to high exposure to emotional situations at work), the PAF could prove more useful to decision-makers than the RI. In terms of interpretation,

Table 4 Final ranking of key WPSF clusters for mental health at work based on the GHQ-28 score

| Cluster name and ranking | WPSFs in the cluster | Description |
|---------------------------------------|----------------------|--|
| 1—Managerial communication at work | 5 | <i>Inverse of:</i> The communication and information exchange process within my company is satisfactory. |
| | 3 | <i>Inverse of:</i> Company performance appraisals and promotions are fairly done. |
| | 22 | <i>Inverse of:</i> I have a good idea of my career prospects within the company. |
| 2—Support from colleagues | 18 | <i>Inverse of:</i> I know that I can depend on the people I work with. |
| | 6 | <i>Inverse of:</i> My work environment is pleasant. |
| | 26 | <i>Inverse of:</i> My work relationships are a source of satisfaction. |
| 3—Personal/professional balance | 9 | <i>Inverse of:</i> I have no problem handling my professional and private responsibilities. |
| 4—Emotional strain at work | 36 | My job puts me into trying emotional situations. |
| | 38 | Sometimes I feel afraid when I do my job. |
| 5—Rewards from work | 44 | <i>Inverse of:</i> I am satisfied with the compensation I receive for my job. |
| 5—Professional evolution perspectives | 43 | I am fearful for my professional future. |
| | 10 | I am unable to plan what my job will be in 2 years. |
| 7—Means provided | 21 | <i>Inverse of:</i> I have the necessary resources and technical means to correctly do my job. |
| 8—Support from the hierarchy | 16 | <i>Inverse of:</i> My hierarchy supports and helps me when needed. |
| | 32 | <i>Inverse of:</i> I get along well with my hierarchy. |
| | 13 | <i>Inverse of:</i> In my job, I feel valued and recognised. |
| | 33 | <i>Inverse of:</i> I feel morally supported in my job. |
| 8—Pride in work accomplished | 37 | <i>Inverse of:</i> I'm proud of what I do in my job. |
| | 39 | <i>Inverse of:</i> I am proud of my company. |
| | 20 | <i>Inverse of:</i> My job makes me feel useful and gives me self-esteem. |

GHQ-28, General Health Questionnaire; WPSF, work-related psychosocial factor.

PAFs only make sense under the assumption of a causal relationship, which will be better investigated using individual longitudinal data. However, they were used here for a ranking purpose only.

Overall, our main findings are consistent with existing models and theories of the impact on mental health at work of management of human resources and organisation.

Among those, we can mention the job demand-control model by Karasek.³ In 1979, Karasek showed that a high job demand associated with low job control (decision latitude) is associated with high job strain as well as physical and mental health outcomes. This model was enriched in 1990 with social support that appeared to be stress buffering.²³ Second, the effort-reward imbalance model,

Table 5 Logistic regression of psychosocial factors (WPSFs) on the binarised outcome 'GHQ-28 score ≥ 24 '

| WPSF No | OR | 95% CI | Prevalence (%) | PAF (%) | Ranking |
|---------|------|--------------|----------------|---------|---------|
| 36 | 1.57 | 1.27 to 1.95 | 43 | 20 | 1 |
| 43 | 1.52 | 1.23 to 1.88 | 42 | 18 | 2 |
| 8 | 1.36 | 1.09 to 1.69 | 60 | 18 | 3 |
| 44 | 1.38 | 1.11 to 1.72 | 52 | 17 | 4 |
| 18 | 1.72 | 1.36 to 2.17 | 27 | 16 | 5 |
| 5 | 1.41 | 1.12 to 1.77 | 43 | 15 | 6 |
| 9 | 2.03 | 1.57 to 2.61 | 15 | 13 | 7 |
| 1 | 1.31 | 1.05 to 1.63 | 38 | 10 | 8 |
| 21 | 1.26 | 1.00 to 1.58 | 24 | 7 | 9 |

Description of the WPSF items is available in [table 1](#).
GHQ-28, General Health Questionnaire; PAF, population attributable fraction; WPSF, work-related psychosocial factor.



proposed by Siegrist⁴ in 1996 to assess adverse health effects of stressful experience at work, suggests that a mismatch between high efforts spent and low rewards received at work can have adverse effects on health and well-being. Lastly, the motivator and hygiene theory of Herzberg²⁴ argues that employee satisfaction has two dimensions: hygiene (salary, supervision, ...) and motivation (recognition, achievement, ...). Herzberg theorised that once the hygiene issues have been addressed, the motivators create satisfaction among employees.

GHQ-28 subscales

Through factor analysis, the GHQ-28 has been divided into four subscales of seven items: somatic symptoms, anxiety/insomnia, social dysfunction and severe depression. It appears that the correlation between the four dimensions and the total GHQ-28 score was more than 0.76. Regarding the correlation between the subscales, the lowest correlation was between severe depression and somatic symptom subscales ($r=0.47$), and the highest correlation between anxiety/insomnia and somatic symptom subscales ($r=0.73$). For more details, see online supplemental appendix F.

Using the weifila approach, the appropriate analysis of WPSFs ranking for these four dimensions was conducted. The results of the top 10 WPSFs ranking are available in online supplemental appendix G. The top three WPSFs in the global ranking appeared in the ranking of all the four GHQ-28 subscales, namely WPSFs 5, 18 and 9. In addition, specific results were found in two GHQ subscales: severe depression and social dysfunction. Regarding severe depression, three other WPSFs come out important: WPSF 1 (doing monotonous and repetitive tasks at work), WPSF 24 (difficulties to reach the objectives) and WPSF 29 (having someone or some people in the workplace who enjoy making me suffer). Regarding the social dysfunction subscale, two WPSFs more are important: WPSF 28 (working in a hectic and noisy environment) and WPSF 30 (not being responsible for working hours and breaks).

Strengths

To our knowledge, this is the first study considering jointly the importance of WPSFs and their prevalence for decision-making in work-related health using multivariate approaches. Earlier studies on WPSFs and their impact on mental health in the workplace seldom included a ranking of WPSFs and never accounted for their proportion of exposure. In addition, this study benefited from the quality and extensiveness of the 'Baromètre Travail et Santé Psychique' database. The use of the validated GHQ-28 questionnaire allowed a better comparison with the existing results in the literature and better psychometric quality. Furthermore, the representativeness of the sample allowed to draw scientific conclusions easily generalisable to all employees and the availability of several individual covariates allowed to produce multivariate analyses with robust results. Finally, our results are all stronger that the same key WPSFs were consistently identified using

two distinct parametric and non-parametric approaches. As correlation does not imply causality, a causal analysis is needed to complete all the results already obtained to identify the drivers of mental health improvement.

Limitations

However, our study presents some limitations. First, the weifila approach proposed in this paper to evaluate WPSF importance assumes a continuous outcome, thereby potentially limiting its applicability to other occupational health data sets. On the other hand, the random forest approach allows for both binary and continuous outcomes. Second, the cross-sectional design of the 'Baromètre Travail et Santé Psychique' survey limits the interpretability of our results. In this type of design, causal attribution is difficult to demonstrate. Employees with high GHQ-28 scores (reflecting depression or anxiety symptoms) may indeed present cognitive bias and dysfunctional thoughts, leading them to perceive their work environment more negatively than those who are in good mental health. In this case, acting on the 'key' WPSFs we identified would have no impact on the mental health of employees. In addition, both WPSFs and mental health were evaluated using self-reported measures, potentially increasing the proportion of misclassification. Reverse causality between mental health and WPSFs cannot be entirely rejected. Nevertheless, previous prospective studies also found an impact of several of our 'key' WPSFs, including support from coworkers and hierarchy, emotional demands at work, work-life balance, work recognition and professional future, on mental health.²⁵⁻³¹ Finally, the R^2 of the linear regression model used in the weifila approach was not very high. Our model explained only 18.4% of the variance of GHQ-28 score. While low R^2 may be expected with binarised predictors, this could also imply that factors other than those documented in the 'Baromètre Travail et Santé Psychique' survey could be responsible for a large part of the participants' mental health level, thereby potentially limiting the potential impact of actions focused on the key WPSFs we identified. On the other hand, the R^2 obtained with the random forest approach was higher at 32%, as its non-parametric nature made it more robust to WPSF dichotomisation. As the WPSF rankings obtained with the weifila and random forest approaches were very similar (Spearman correlation of 0.88), this suggests that our results may still be useful for decision-making.

Implications for practice

Our study identified the top WPSFs that impact mental health in the workplace. In particular, our study suggests that interventions based on training workplace managers to better communicate with and support their employees could be highly effective, in accordance with a recent systematic review.³² However, to ensure that such strategies follow the Specific, Measurable, Achievable, Realistic and Timely approach, they need to be defined and monitored by multidisciplinary teams including organisational

and management experts, occupational physicians and staff representatives.^{33 34}

Implications for further research

This study, methodological in nature, raises a number of opportunities for future research. First, we developed an RI allowing to hierarchise WPSFs most impacting mental health that we believe to be methodologically robust. In future research, this RI could be used on longitudinal empirical data to further confirm the areas we identified as strongly associated with mental health. Second, this paper mostly focuses on individual perception of the level of exposure to psychosocial characteristics at work. In further research, the RI could be enriched by using company-level data to account for more organisational or management features, for example, company and team size.

CONCLUSION

In this study, we use two multivariate approaches to identify psychosocial factors that need priority actions in the workplace. The results underline communication exchanges within the company, social relations at work, imbalanced private and personal lives, hierarchy support, emotional burden, compensation received, professional future, resources provided and pride in the work as key factors. These findings may inform mental health prevention efforts and intervention programmes. In this regard, it has the potential to help improve the quality of life (and productivity) of employees.

Contributors OSD analysed and jointly interpreted the data and wrote the first draft of the manuscript, and is the guarantor of the submitted manuscript. LT, GS and MNH interpreted the data and contributed to the manuscript. AC, PL and RG conceived the project and interpreted the data. OSD, AC, LT, PL, RG, GS and MNH contributed to the final approval of the completed manuscript.

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Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and the 'Ipsos Access Panel' is acknowledged by the French national data protection authority (CNIL) and is compliant to the ICC/ESOMAR International Code on Market, Opinion and Social Research and Data Analytics (https://www.esomar.org/uploads/public/knowledge-and-standards/codes-and-guidelines/ICCESOMAR_Code_English_.pdf). All participants answered the questionnaire voluntarily after giving their informed consent online and could unsubscribe from the survey without influencing the panel membership. Since the study did not involve any human experimentation and the online questionnaire was proposed to volunteers of the Ipsos Access Panel, in respect with data protection standards of the French law, we did not seek for the

approval of an ethics committee. Participants gave informed consent to participate in the study before taking part.

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