

Psychosocial and Biological Indicators in the Evaluation of and Intervention in Mental Health Problems at Work



INVITED ESSAY

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ABSTRACT

This article discusses how biological and psychosocial perspectives might integrate into a unified framework – the bio-psychosocial model – that can be used to explain how mental health problems at work are generated and that can be subsequently employed in workplace intervention. It concludes with a brief review of the advantages and ethical pitfalls that arise with this approach.

MENTAL HEALTH PROBLEMS at work, such as psychological distress, depression and burn-out, are among the leading and most costly causes of absenteeism in the workplace. A report in 2000 from the International Labour Office stated that psychological distress affected between 15 and 20% of workers in Europe and North America; and it has been

reported that 19% of Canadian workers experienced repeated episodes of psychological distress between 1994–1995 and 2000–2001 (Marchand et al. 2005a, 2005c). Costs associated with mental illness (in terms of absenteeism, productivity, indemnities and healthcare) were estimated at \$51 billion in Canada in 2003 (Lim et al. 2008).

Significant in size and consequences, problems related to psychological distress, depression and burnout are difficult to diagnose and are sometimes intermittent. Researchers use many tools to identify and measure these mental health problems, but they lack objective tools that would provide a clear picture of the problems, as well as their causes. While most psychosocial oriented studies focus on stressors (e.g., work, family, socio-economic status etc.) and outcomes (e.g., psychological distress, depression, burnout etc.), the stress response itself is rarely or poorly measured. One main reason for this is that the psychological self-reported questionnaires used to assess the stress process do not adequately measure how stressors affect the body to produce detrimental outcomes for mental health. Stress is often assumed to be a “black box” hiding the mechanisms promoting mental health problems in workers. Hence, there is a need to incorporate into the research design physiological measures that can identify states of chronic stress at an earlier point in the stress process.

In this article, we discuss how biological and psychosocial perspectives might integrate into a unified framework that can explain how mental health problems at work are generated and subsequently how we can intervene. The bio-psychosocial approach adopted by the *Équipe de Recherche sur le Travail et la Santé Mentale* (ERTSM [Research Team on Work and Mental Health]) at the University of Montreal relies on a theory that puts forward the role of environmental stressors leading to biological dysfunction (stress) and finally conducting individual strains and diseases. ERTSM uses both psychosocial (questionnaire) and biological (cortisol and alpha-amylase in saliva samples) measurements to capture how stressors in the environment produce a stress reaction in the individual body (stress response) and influence disease

production, in particular symptoms of psychological distress, depression and burnout. With such an approach, the biological stress response could be evaluated and linked to symptoms of mental health reported in questionnaires; and the stressors evaluated by the questionnaire could be linked to the biological stress response as well as to reported symptoms of mental health. Therefore, subjective and objective evaluations are jointly integrated and are expected to produce a better evaluation of both symptoms and determinants of workers’ mental health, as well as better intervention results.

We will now examine the bio-psychosocial model explaining workers’ mental health, discuss the use of this model for workplace intervention and briefly review advantages and ethical pitfalls that arise with this approach.

Bio-psychosocial Model of Workers’ Mental Health Psychosocial Factors

There is growing evidence that psychosocial factors at work relate to mental health outcomes. A large array of work characteristics (skill utilization, decision authority, psychological and physical demands, work hours and schedule, harassment and aggression, social support, job security, rewards and recognition etc.) are stressors contributing to psychological distress, depression and burnout (Bonde 2008; Marchand and Blanc 2010; Marchand et al. 2005a, 2005b, 2006; Netterstrøm et al 2008; Stansfeld and Candy 2006), and workers at the mid- to lower levels of the occupational hierarchy (white-/blue-collar workers, unskilled workers) experience a higher frequency of psychological disorders (Marchand et al. 2005c; Niedhammer et al. 1998; Sanne et al. 2003; Stansfeld et al. 2003; Wieclaw et al. 2005). Two main theoretical models have sought to explain the relationship between work and mental health: the Demand-Control-

Support model (Karasek and Theorell 1990), which extends the Job Demand–Control model (Karasek 1979) and the Effort–Reward Imbalance model (Siegrist 1996). Because these models are well known, we do not describe them in detail here. It is important to note, however, that while the components of Karasek and Siegrist models are well supported empirically, recent reviews of longitudinal studies concluded that the interactive hypotheses of these models are inconclusive (Bonde 2008; Netterstrøm et al. 2008; Stansfeld and Candy 2006). These inconsistencies and the failure to demonstrate support some of the major hypotheses of these models indicate that other factors are at play in the explanation of mental health status in the workplace.

To begin, one must recognize factors outside of work (Bonde 2008; Marchand and Blanc 2010; Marchand et al. 2005a, 2005b; Virtanen et al. 2008). Studies have stressed the role of non-work factors – such as marital status and parental responsibilities, strained relationships (e.g., with spouses, children, friends and neighbours), the economic situation of the household, the conciliation of work and family and a variety of sources of social support and participation in social networks – as important to mental health problems. When it comes to demographics, mental health problems have been shown to be more prevalent among women and to decrease with age. Educational level, physical health status, personality traits and lifestyle habits such as alcohol consumption, smoking and physical exercise patterns introduce further sources of variations. Finally, inadequate coping strategies and stressful life events are also considered to be important. All of these factors have been reviewed elsewhere (Marchand et al. 2005b; Stansfeld 2002) and are consistent with the multi-level theoretical model of mental health determinants in the workforce (Marchand et al. 2005a, 2005b, 2006). Surprisingly, however, with the excep-

tion of a few reports, most studies linking work and mental health fail to integrate or control for these other aspects of an individual's life. This may explain why work in this area leads to results that tend to be gender biased: more gender-specific factors such as balancing work and family demands in women or men with no or low spousal support, and discrimination barriers to financial and career development in women can induce significant stress in today's workforce. The transportation of stress from family to work and from work to family (negative spillover effects) might also have a significant impact on today's workers' mental health.

Biological Factors

On the biological side, we now know that enduring stressors may produce states of chronic stress that can lead to mental health problems because of the activation of a physiological stress system in the body called the hypothalamic-pituitary-adrenal (HPA) axis. This axis controls the secretion of the two major stress hormones in the body: glucocorticoids (called cortisol in humans) and catecholamines (adrenaline and noradrenaline). The catecholamines are the first hormones to be produced in response to stress, and their acute secretion has been shown to be associated with an emotional enhancement of memory of fearful and stressful events. Cortisol is secreted after the catecholamines and is involved in the energy mobilization needed to respond to the stressor. Various studies have shown that exposure to high levels of cortisol lead to impairments in attention (Lupien et al. 1999), emotional processing (Maheu et al. 2004) and learning and memory (Lupien et al. 1994, 1998, 2002a, 2002b) as cortisol easily and rapidly crosses the blood-brain barrier and accesses three brain regions known to be involved in emotion, learning and memory (Anderson and Phelps 2001; Connolly et al. 2002; Owen et al. 1996; Tulving 2002). Other

studies have shown that cortisol secretion is dysregulated in depressed individuals (higher than normal level) (Pruessner et al. 2003; Sachar et al. 1973), in individuals suffering from burnout (lower than normal level) (Pruessner et al. 1999) and also in chronic alcohol intake and acute alcohol withdrawal (Junghanns et al. 2003; Kiefer et al. 2006; Olive et al. 2003; Sillaber et al. 2002).

In the mid-1990s, non-invasive methods were developed allowing the measurement of cortisol in human saliva (Kirschbaum and Hellhammer 1994). Since then, a growing number of studies have demonstrated the validity and reliability of these physiological measures in assessing cortisol levels and at predicting stress-related disorders (Kirschbaum and Hellhammer 1994). More recently, salivary proxy measures (salivary amylase, salivary alpha-amylase) of catecholamines have also been developed and used in many studies regarding physiological stress (Chatterton et al. 1996, 1997; Kirschbaum et al. 1993; Li and Gleeson 2004; Nater et al. 2005, 2006; Rohleder et al. 2004; Takai et al. 2004; Walsh et al. 1999). Some studies have assessed salivary stress hormone levels as a function of workplace stress. For example, awakening cortisol response has been shown to be more pronounced on weekdays than on the weekend (Kunz-Ebrecht et al. 2004; Schlotz et al. 2004), particularly for individuals reporting higher levels of chronic work overload and worrying. The catecholaminergic system has also been shown to be sensitive to work stress, with heart rate and blood pressure being higher during workdays than in the evening or on leisure days (Evans and Steptoe 2001). Another study has measured a model of effort-reward imbalance and over-commitment to work using cortisol measurements during workdays, with results showing that the awakening cortisol level is positively associated with over-commitment in men

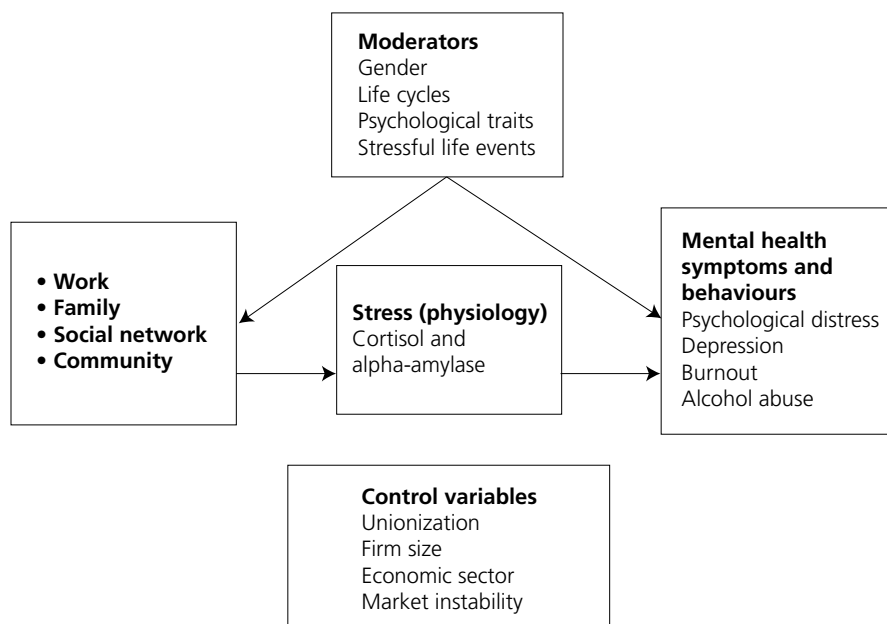
only (Steptoe et al. 2004). Some studies using salivary stress hormones have also been conducted to assess work-family related stress.

Difficulties in harmonizing work and family duties for women with children at home are associated with higher catecholamine levels after work than for women without children and for men with or without children (Lundberg and Frankenhaeuser 1999). Another study (Barnett et al. 2005) showed that men and women with more marital concerns reported greater stress throughout the day and flatter cortisol slopes during the day (due to blunted cortisol levels in the morning) when compared with individuals with low marital concerns. Another study (Sudo et al. 1995) found that urinary noradrenaline and salivary cortisol levels in women with children showed a tendency to be higher in the afternoons and evenings on workdays than on days off, while no difference between workdays and days off was observed in working men or working women without children, suggesting carryover effects from family to work stress. Finally, a study performed in white-collar workers showed that both psychological distress and stressful daily events at work and/or at home were associated with higher cortisol levels (van Eck et al. 1996).

In summary, and assuming that mental health disorders are stressor-related disorders that develop over time, these biomarkers of stress (cortisol and alpha-amylase levels) may be very important items to measure, early in the process, states of chronic stress that could potentially lead to mental health disorders such as depression and burnout.

Integrating Psychosocial and Biological Factors

Figure 1 illustrates the ERTSM biopsychosocial model, which is based upon the assumption that mental health problems result from chronic stress, which itself occurs from

Figure 1. ERTSM bio-psycho-social model of workers' mental health

ERTSM = Équipe de Recherche sur le Travail et la Santé Mentale.

exposure to enduring work and non-work stressors, a process modulated by individual factors. Multiple levels of stressors (work, family, community) are considered in order to further capture the complexities involved in the stressor-strain process that has been theorized and partially tested in psychosocial studies (Marchand and Blanc 2010; Marchand et al. 2005a, 2005b).

The model hypothesizes, first, an association between perceived stressors and stress measured physiologically (cortisol, alpha-amylase) and, second, an association between the latter and mental health outcomes. From the work domain, stressors are located at (1) the individual level (occupation, skill utilization and decision authority, physical and psychological demands, working hours and schedule, social support from colleagues/supervisor, job insecurity, harassment/aggression, abusive supervision, efforts and rewards, non-work to work conflicts); and at (2) the

workplace level (organizational culture and politics, work-family culture, industrial relations climate, risk tolerance, organizational learning climate, organizational stress interventions, individually targeted interventions, occupational health and safety structures and resources). Non-work stressors originate from the family (marital, parental and economic statuses, marital and parental strains, household chores, work to

non-work conflict), the social network (social support) and the community (economic status, access to daycare). The model postulates that individual characteristics of gender, life cycles, psychological traits and stressful life events relate to mental health, while moderating the relationship between work and non-work stressors and the stress states, and the relationship between the latter and mental health outcomes. Finally, because the model integrates workplace-level factors, there is a need to control for unionization, firm size, economic sector and market instability.

By combining subjective and objective evaluations of stressors and strain, ERTSM is able to identify how stressors get into the body to produce detrimental outcomes for mental health. It is also possible for us to examine cut points for self-reported mental health measurement as a function of cortisol and alpha-amylase levels; this will help in the earlier detection of psychological distress, depression

and burnout symptoms. Subsequently, the questionnaire can be better calibrated for improved reliability in detecting cases versus non-cases of mental health problems.

Let's now look at how such an approach is expected to produce better intervention results.

Bio-psychosocial Model in Intervention Occupational Stress Intervention

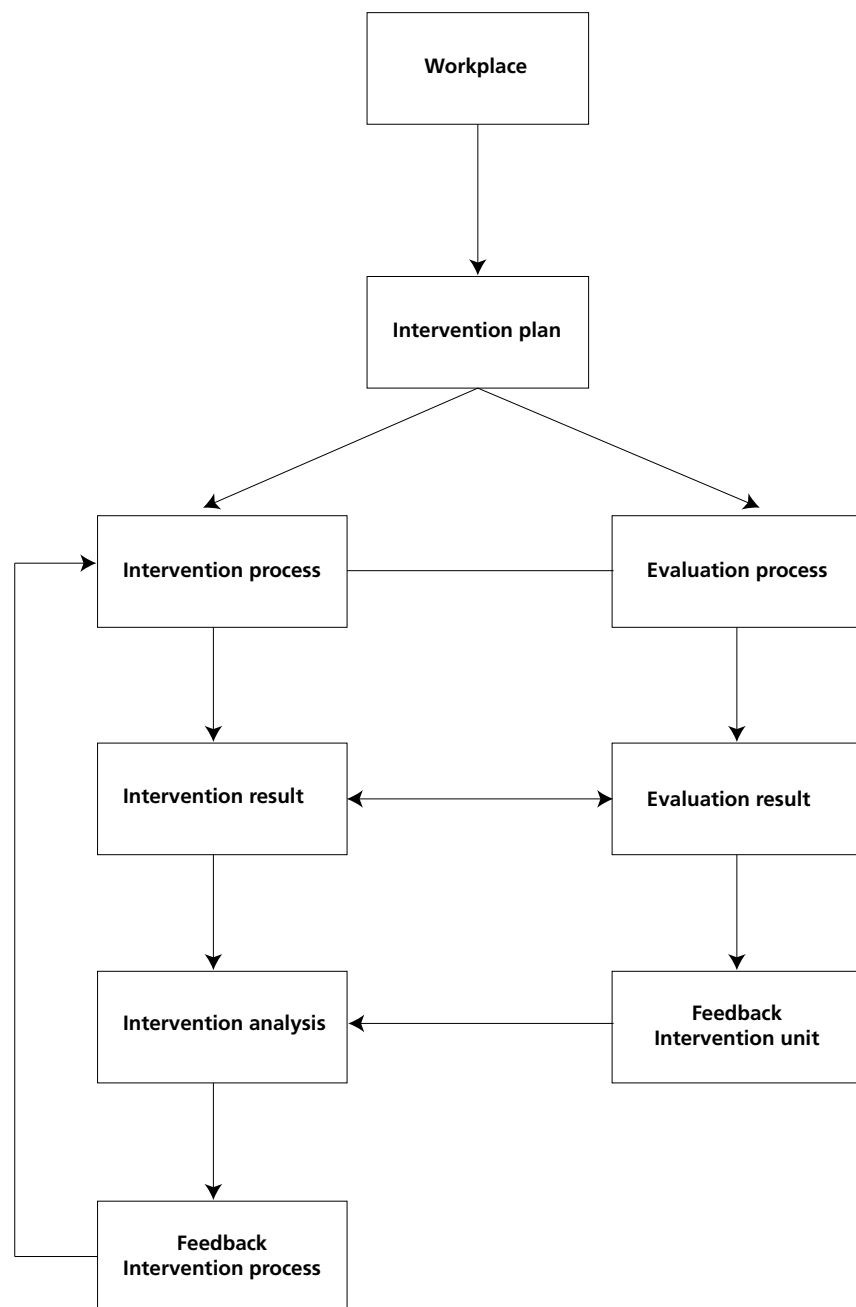
Comprehensive reviews of research on interventions for occupational stress (Caulfield et al. 2004; Giga et al. 2003; Harvey et al. 2006; Parkes and Sparkes 1998; Rick et al. 2002) show that we have a good level of knowledge about organizational interventions but are lacking adequate evaluations for their effectiveness. So far, the strongest evidence on effective interventions aimed at stress reduction comes from socio-technical interventions that focus on the structural/objective elements of work (e.g., work scheduling, job design [Parkes and Sparkes 1998]). A high degree of agreement in perceptions regarding these sources of stress is likely an important factor explaining the success of these types of interventions. It also underscores the importance of primary interventions that are focused on removing the major, agreed-upon sources of stress from particular work environments. However, many psychosocial stressors are more linked to subjective perceptions (e.g., role conflict and ambiguity, hostilities at work, skills under-/overused etc.), and changes to these risk factors at work are more challenging and difficult to evaluate. This is a likely reason why studies have so far been mixed in their findings (Harvey et al. 2006).

Nevertheless, these difficulties are surmountable when various elements of intervention success and evaluation are considered. The first critical element is that stress intervention is an ongoing process (Kompier et al. 2000) that will hopefully lead to technical and normative changes on matters of mental

health. These changes might involve modifications in workloads and work schedules and even impose minimal resting time between work shifts. Hence, the conceptualization and evaluation of these programs must be oriented for the mid- to long term and be focused on both the process (how) and the content (what) of the intervention (Harvey et al. 2006; Kompier et al. 2000), given that it may need to bring change to a range of elements related to work and non-work factors. From an evaluation standpoint, this necessitates, among other things, flexibility in measurement approaches (qualitative and quantitative) and a multiplicity of outcomes to be measured over time (Hurrell 2005; Parkes and Sparkes 1998) to capture the complexity of the process and content dynamics. Another important element is to ensure that a true fit is established between the problem and the solution through an effective risk assessment (Hurrell 2005; Kompier et al. 2000; Rick et al. 2002); a realistic intervention that is evidence-based should be used whenever possible (Briner 1997; Harvey et al. 2006; Rick et al. 2002). An examination of case studies of interventions suggests that successfully accomplishing these elements is largely based on using a systematic risk management approach to the problem, with genuine involvement from all groups within the organization (Cox et al. 2000; Kompier et al. 2000).

Cox et al. 2000 provide interventionists with an excellent framework, with details for accomplishing all of these intervention strategies. Drawing on risk management knowledge in applied psychology and management science, authors in these fields have put forth a risk management process that is tailored to the reality of occupational stress. It also parallels nicely the intervention research agenda and framework put forth by the National Occupational Research Agenda research team (Goldenhar et al. 2001).

Figure 2. ERTSM intervention model



ERTSM = Équipe de Recherche sur le Travail et la Santé Mentale.

Integrating Psychosocial and Biological Factors in the Intervention

Figure 2 describes the intervention model of ERTSM, a five-step model of risk management for work stress. The first critical step involves workplace risk assessment wherein

an analysis of the current and ongoing situation provides an details of stressors, levels of physiological stress (cortisol, alpha-amylase) and associated mental health problems by using data collected by the research team; these are further enriched with additional data gathered through on-site interviews of executives. This workplace assessment takes into account the observed factors related to individual, family and community considerations.

The second step is critical to implementation success and involves translating assessment data into information that the organization can understand, accept and use in the risk reduction step to follow. The goal is to ensure that organizational members understand and take ownership of the information so that the data truly become actionable information for them. The risk reduction step then follows, with concern for the design and implementation of

the intervention plan. Careful contemplation on the intervention is necessary, including consideration of existing evidence supporting the proposed intervention and whether it truly fits the problem.

The intervention plan is then subdivided in a two-pronged evaluation step. On one side, the intervention is implemented by a first section of the research team, and results are obtained. The intervention results are then analyzed. Several evaluative tools can be used, but it remains important that the intervention process remains open to ongoing modifications. The other side of the intervention proceeds in a concurrent fashion. While the intervention is processing, another section of the research team collects data about it in an independent manner. As soon as the intervention results are obtained, these are evaluated by the second research section of the team.

In the subsequent step, this latter research section provides its evaluation to the first section once the intervention is completed, and also provides some feedback on the intervention process. The purpose of this double-sided approach is, first, to be able to provide an independent evaluation of the intervention and, second, to provide, with the help of an independent observer, another form of evaluation, which is concerned more about the nature of the intervention and how it is implemented. The learning and training step is then also part of the process of risk management.

The process is thus completed by an exchange between the evaluation and intervention teams so that learning from the evaluation can occur and also be transferred back to the participating company.

This intervention model focuses more on the intervention and evaluation process than on the content. Hence, it should be completed by two additional remarks resulting from the research design. First, this model is used for designing, implementing and/or evaluating preventive interventions or practices addressing the following three sets of stressors: (1) work-family conflict and imbalance; (2) downgraded work climate, lack of social support, and harassment at work; and

(3) psychological demands and decision authority imbalance related to work organization/job assignment or design. These problems have been targeted for best practices development and testing because existing research suggests that they are important sources of stress relevant for occupational mental health and provides indications or documentation about pathways for solutions (Artazcoz et al. 2004; Frone 2000; Haines et al. 2006; Marchand and Blanc 2010; Marchand et al. 2005a, 2005b, 2006; Schat and Kelloway 2005). Second, the intervention model is used for conducting before-after evaluation studies, and it will also be used in a modified version to perform ex post evaluative studies.

Ethics and the Workplace

Conducting this type of research in the workplace brings both advantages and ethical pitfalls. First of all, as mentioned previously, quantitative research including both a systematic evaluation composed of a questionnaire and a biological measurement should provide a more solid diagnosis of the workplace situation. Moreover, this evaluation follows a strict stratified and randomized design. Secondly, interventions are administered following a stratified and randomized design, and this is rather rare given the difficulties it entails. However, using this type of design provides a non-biased estimate of the true effects of interventions by taking into account external factors to the workplace such as social support from the family and the community or negative events occurring in one's life. Many ethical pitfalls stem from this type of research, and some of them are presented in Table 1.

The first type concerns the use of questionnaires aimed at gathering workplace information but also personal and family information. To ensure a high level of participation, we must therefore guarantee responder

anonymity and confidentiality of collected data. Another concern is the responsibility of any research team that is implicated in a health intervention process. We cannot blind ourselves in the face of a situation that might be significant in the preservation of someone’s physical or mental integrity. Hence, we have set up some criteria triggering action when a participant shows, for example, a high score on the Beck Depression Inventory. In such a case, the participant is urged to consult a specialist at the nearest possible time.

The second type of ethical pitfall concerns the information provided by the human resources executives when interviewed by our research team. We have to take precautions in order to prevent any leak that could put them in a difficult position. The interviewed people are well known by employees, and identifying their company would automatically identify them in return.

A third ethical concern involves the saliva sampling. Even though we measure only two parameters, the perception is that we could measure many more things. These param-

We cannot blind ourselves in the face of a situation that might be significant in the preservation of someone’s physical or mental integrity.

eters, which would have necessitated blood sampling only a few years ago, can now be measured in the saliva, but so can many more substances, such as some illicit or licit drugs (cocaine, etc.). So we need to be quite clear by stating our engagement to limit measurements to the two explicitly named components (cortisol and alpha-amylase) in the informed consent. Moreover, even if researchers want in the distant future to measure different parameters in the same samples, they will have to go back for approval to the participants, if identities are available (which is not the case in our study). Subsequent to the sampling, results should not be analyzed on an individual basis

Table 1. Ethical pitfalls

Pitfall	Importance, Legal Constraints, Ethics
Questionnaires: <ul style="list-style-type: none"> • Anonymity of responders • Confidentiality of data • Informed consent • Responders with a score >29 on the Beck Depression Inventory are advised to consult a specialist 	High importance, legal Ethics Ethics Legal
Interviews with human resources executives: informed consent	Ethics, in some cases legal
Saliva sampling (cortisol and alpha-amylase): <ul style="list-style-type: none"> • Anonymity of participants and confidentiality of data • Specific informed consent • Limited number of parameters • Confidentiality of results (not transmitted to a third party or to the employer on an individual basis) • Interpretation of results (screening vs. diagnosis) 	High importance, legal Ethics Ethics Legal and ethics Ethics
Interventions in companies: <ul style="list-style-type: none"> • Commitment toward confidentiality of all data obtained from companies • Commitment toward confidentiality in company operations (commercial base protection) • Company consent to make company insurance data available at the insurer 	Ethics and legal Ethics and legal Ethics and legal

since cortisol and alpha-amylase are not diagnostic tests in this instance and are to be used as screening tests. Hence, since they cannot be used to refer workers to physicians, analyses provide aggregate results that are used to compare groups. Furthermore, individual results cannot be transferred to a third party, such as an insurance company, and used as part of an individual's medical claim file.

Finally, a fourth type of concern regards interventions in workplace settings. First, on the company side, there is an overwhelming question about the confidentiality of information provided by the company. Every company is worried that data collected by a research team could end up with third parties and have some negative effect on the risk analysis of its portfolio or on workers' compensation board records, which, in turn, could engender an increase in fees. Second, the company may fear that the welcoming of a research team within the confines of an industrial setting may result in a transfer of delicate information to competitors. This would endanger the competitive commercial base of the company under study. The same could be said about company data transferred from a third party to the research team. In all these instances, we have to provide guarantees regarding the confidentiality of information.

Finally, direct interventions in six followed-up companies impose constraints with regards to the types of interventions and their specific results. Consequently, the results will be reported in order to protect sensitive outcomes regarding individuals involved in the interventions. The last aspect concerns the limits of the research team role. Considering the nature of scientific research, it was stated that the research team would not act in replacement for clinical work that should be done in a professional context and that the team would not act as a replacement for a management consultant.

Conclusion

The identification and evaluation of mental health problems at work comprise a crucial problem to be solved if we are to make progress in reigning in the damage to workers' health and the subsequent costs to all parties involved in the workplace. Numerous studies have used mainly questionnaires to evaluate mental health problems. Many of those questionnaires had gone through rigorous validation studies (Ilfeld 1976; Karasek and Theorell 1990; Kessler et al. 1998); but in some cases, validation studies were not so extensive (Viviers et al. 2008) or were confined to specific work settings or occupations (Hayasaka et al. 2007). These questionnaires enabled researchers to evaluate the magnitude of the problem (e.g., through measurement of frequencies or relative scoring systems) or to follow the frequency of problems in populations on a periodic basis (Stansfeld et al. 2003). Even though questionnaires offer valuable information, they are often the subject of criticism because they are based on individual perceptions and therefore do not offer any reference to a possible gold standard. Biological measurements are often thought to be more objective since they usually offer quantitative measurements with a higher reproducibility. However, many biological parameters provide non-specific information and are thus of no use in the detection of health problems. Cortisol and alpha-amylase measurements are not specific with regards to mental health problems since their values can vary in many types of health situations, even favourable ones. Nevertheless, it might be possible to obtain a more solid confirmation of an ongoing negative mental health situation when both the questionnaire results and the biological values concur. This has to be tested thoroughly taking into consideration the ethical aspects engendered by the testing process.

A second problem to be addressed

concerns the identification and evaluation of meaningful interventions in the workplace. Once mental health problems have been identified in a target workplace, specific and efficient interventions must be implemented and evaluated in terms of efficacy. All kinds of interventions have been reported in the literature, but comparative studies have shown that results are often contradictory. In some cases, even positive results are so short lived that the interventions are not worth doing. In other cases, intervention evaluations do not take into account the Hawthorne effect (Gillespie 1991; Sonnenfeld 1985) that inevitably accompanies human interventions in the workplace. It is possible, though, to draw a list of the most credible interventions and try them in a controlled setting. To do this we have to compare two groups of companies, a high-performance organization with successful interventions and a low-performance company in need of interventions. The companies are followed up with the same tools (e.g., questionnaire and biological measurements). A research team observes the effect of interventions at different times in order to evaluate their true effect.

Biological measurements are often thought to be more objective since they usually offer quantitative measurements with a higher reproducibility.

Finally, intervention evaluation is both objective and subjective in nature, and both the result and the process are important. Employee reactions to interventions are modulated not only by the content or type of intervention but also by how we intervene and administer

features of the intervention, thus influencing employee perceptions. This is why an independent observation team can provide needed and useful information about the quality of the intervention and possible modifications that could improve efficacy and effectiveness.

Group mental health interventions in the workplace are still in need of development and validation studies. Nonetheless, they must be pursued if we are to make some progress toward both the prevention of mental health problems in the workplace and their resolution when they manifest themselves.

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