RETRACTION

The following article was withdrawn due to the request of the authors on December 17, 2016.

Retraction: Effects of an Ergonomics-Based Job Stress Management Program on Job Strain, Psychological Distress, and Blood Cortisol Among Employees of a National Private Bank in Denpasar, Bali

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Retraction
Effects of an ergonomics-based job stress management program on job strain, psychological distress, and blood cortisol among employees of a national private bank in Denpasar Bali

Abstract:

The present work describes a newly developed ergonomics-based job stress management program – Ergo-JSI (Ergonomics-based Job Stress Intervention) – including a pilot study to ascertain the effects of the program on job strain, psychological distress, and blood cortisol levels among bank employees in Indonesia. A single-group, pre- and post-test experimental study was conducted in a sample of employees in a National Bank in Denpasar, Bali, Indonesia. The outcomes of the study focused on reductions in job strain index and psychological distress, measured by the Indonesian version of the Brief Job Stress Questionnaire (BJSQ), and improvement in blood cortisol levels following the study.

A total of 25 male employees, with an average age of 39, received an eight-week intervention with the Ergo-JSI. Compared to baseline, the job strain index decreased by 46% (p<0.05), and psychological distress decreased by 28% (p<0.05). These changes were accompanied by a 24% reduction in blood cortisol levels (p<0.05). The newly developed Ergo-JSI program may hence be effective for decreasing job strain, psychosocial distress, and blood cortisol among employees in Indonesia.
Key words: job strain, ergonomics, working conditions, workplace stress management, blood cortisol
Introduction

Stressful work situations have effects on both a psychological and a physiological level\(^1,2\). Job strain is an often applied measure to assess psychosocial stress in the workplace and is defined as high job demands relative to little job-control\(^3,4\). High job strain has been associated with psychological distress\(^5-7\), poor quality of work\(^4\), low work ability\(^8\), and risky behavior\(^9,10\).

Moreover, suboptimal physical environment in a workplace is a known factor contributing to stressful work situations\(^2,4\). High job strain affects employee health through a range of factors. According to the strain hypothesis presented in Karasek’s Job Demand-Control model from 1979, employees working in high-strain jobs with little control over their work, experience the lowest wellbeing\(^11\). Job stress will not affect employees’ physical and/or mental health when sufficient level of control exist\(^11\). One of the most important parameters in this context is an activated stress response, mediated by hypothalamus-pituitary-adrenal (HPA) axis activation, which is leading to increased levels of blood cortisol\(^2,12\).

Previous studies have selectively investigated the effectiveness of individual, or organization-oriented approaches in reducing stress in the workplace. Although these approaches have been proven effective, few studies have applied the above-mentioned methodologies combined in one intervention\(^13\). The notion that the physical environment can contribute to stress in the workplace is not frequently debated. However, a suboptimal physical environment is likely to decrease psychological wellbeing and the sense of control over one’s work situation. Therefore, addressing ergonomic factors is crucial to a successful implementation of a stress management program targeting the workplace. Successful improvement in physiological indicators is not frequently reported in studies covering workplace stress management programs. However, an experimental study by Theorell and colleagues, using an organizational approach at insurance
companies, found a significant decrease in blood cortisol levels in the intervention group\textsuperscript{14}). Also, using a longitudinal approach, Evolahti and colleagues found a decrease in the employees’ blood cortisol levels following a program aiming at improving awareness of mental health in the workplace\textsuperscript{15}), indicating that different aspects of job strain management effectively reduces stress. We hypothesized that integrating the above-mentioned approaches into one program, hence targeting the different sources of job related stress, would render a workplace stress management program more effective. We therefore designed a new intervention program called “Ergo-JSI” (Ergonomics-based Job Stress Intervention), consisting of both an organization-focused component – including optimization of work content and physical environment – combined with an individual focused component in the form of stress management training.

\textbf{Subjects and Methods}

\textit{Study participants and procedure}

The study followed a single group pre- and post-test experimental design and was conducted at a private bank in Denpasar, Bali province, Indonesia. While a total of 34 male and 12 female workers were employed at this bank office, only male employees were selected as study participants in order to reduce confounding effects of hormonal status on stress and cortisol levels. All male employees volunteered to participate, and 25 male employees were randomly selected from the total of 34 male employees. Participants were provided verbal and written information about the study aim and research procedures before providing written consent. The present study was composed of three parts; Pre-intervention measurements and planning, the Ergo-JSI intervention, and post-intervention measurements. The study was reviewed and
approved by the ethics committee of the Research and Development center of the graduate school at the Udayana University, Bali, Indonesia. Suggested ergonomic and organizational changes were reviewed by the company management and Ergonomics Study Center of Udayana University.

The Ergo-JSI workplace intervention program

Ergo-JSI is an author-original idea of a strategy to apply job stress management programs to companies. The program combines job stress management out of an ergonomic, or improvement of working conditions perspective, combined with an individual orientation aspect, placing equal focus on these two components. According to Manuaba, to optimize results in anticipating stress at work, and to attain humane, competitive and sustainable work systems, it is a must to manage stress with a combination of improvement in working conditions and individual stress management – a method termed the Total Ergonomics Approach\textsuperscript{16). The theoretical framework of the Ergo-JSI approach is based on the theory that at least four aspects of individuals’ interactions with their environment will affect perceived job stress. These exchanges are: (1) the demands on the individual\textsuperscript{2); (2) the individual’s ability to cope with those demands\textsuperscript{17); (3) the constraints under which the individual has to cope\textsuperscript{10; and (4) the support they receive from others in coping\textsuperscript{17,18. The benefits of an improved coping ability in facing work demands, and the protection from the risk of job stress such an improvement brings along, is also in line with the “Transactional Model of Stress and Coping” by Lazarus & Folkman\textsuperscript{19).}

An improvement of working conditions through a continuous improvement program with a participatory approach, reduces complexity and, hence, improves the ability to cope and loosens the constraints under which work is performed. By giving workers the opportunity to request
supportive tools or air ideas that could simplify work processes, the support from others also
have the potential to improve, while also improving quality and/or quantity of the work involved.
The interaction with company management also has the potential to increase assertive skills, as
well as provide better social support and, hence, positive emotions. Interactions with
management through a continuous improvement program could, therefore, increase support in
coping regardless of actual changes in working conditions\(^{17, 18}\). Time management skills, are,
likewise, tightly linked to a better ability to manage one’s work demands, and are therefore also
included in the Ergo-JSI. Improving such skills is likely to balance the capacity of the worker
with the workload at hand\(^1, 2, 18, 20\). A deep understanding of job stress mechanisms is another
key to improving coping ability and lifting constraints, since a stressful state of mind can be
considered to constitute a constraint. Along these lines, cognitive restructuring used to increase
positive emotions and the skills to manage negative feelings, has the potential to increase
agreeable behavior. This might lead to better support in coping in addition to improved coping
ability\(^{17, 21, 22}\).

According to Shimazu, stress management interventions are intended to help employees modify
their appraisal of stressful situations, and/or to deal more effectively with the symptom of
stress\(^{17}\). Also Kumashiro argued that to reduce stress and fatigue in workers, it is crucial to
create a balance between the external task and the internal response. Imbalance between work
conditions, the work environment, and the adaptive capacity of the worker, may lead to
unfavorable psychological and psychosomatic responses.\(^1\) In line with this idea, Lamontagne and
colleagues found that stress management programs containing an individual approach, coupled
with an improvement of working conditions (ergonomics intervention) are more likely to use a
systems approach, favorably affecting both individual-level outcomes as well as the
organizational level of a work situation\textsuperscript{23}). In other words, the Ergo-JSI covers improvements of working conditions in addition to improving coping ability of workers\textsuperscript{19}. The term Ergo-JSI mirrors the novelty of the steps, or algorithm, in the job stress management program application. The program targets workplace related stress by approaching it from both an organizational and an individual perspective – using a participatory approach. The organizational aspect of work stress covers improvement of physical work environment, task related improvement of working conditions and organization related improvement of working conditions. The individual-centered part of the Ergo-JSI consists of a classroom based stress management program. The training provided a basis for the participants to understand how job stress mechanisms affect their body and mind, aiming to improve employee skills in problem-focused coping, in order to reduce job stress\textsuperscript{6,17}). The training, hence, consisted of sessions targeting time management, communication skills, and improvement of personal skills. The Ergo-JSI program was designed to improve working conditions\textsuperscript{6,18)}, and to potentially increase individual psychological resources\textsuperscript{17,24,25}). The primary outcomes of the program were reductions in job strain and psychological distress. A secondary outcome was to reduce blood cortisol levels in the participants.

\textit{Pre-intervention measurements and planning}

\textit{Questionnaires and Survey}

The Mental Health Action Checklist (MHACL)\textsuperscript{26}), combined with Ergonomic Check Points (ECP)\textsuperscript{27,28}), was used to identify particulars of the working conditions that needed improvement. The ECP was complemented with a walk-through survey to get a more complete picture of the working conditions. The survey took the task, organization, and environment aspects of ergonomics into account. The Brief Job Stress Questionnaire (BJSQ)\textsuperscript{29}), was used to measure the
main outcomes of the study; job strain and psychological distress. Two subscales formulate the
part of the BJSQ measuring job strain; job demand and job control. The questionnaire uses a 4-
point Likert scale, ranging from 1 (agree) to 4 (disagree). Job strain index is then calculated by
dividing the score of job demands (7 items) by job control (3 items). A high score is, hence,
representative of severe job demands with little control over the work situation. Another part of
the BJSQ measures psychological distress, and is composed of 18 items\(^{39}\). A high score
indicates a high level of psychological distress. All surveys were performed in coding, with
individual results available only to the research team. Participants were informed that all their
individual data from BJSQ questionnaire was confidential. The company was informed that the
research team would share only a report of analyzed results with the management. The report
was presented during a study result meeting with all participants. The individuals had the
possibility to access their individual data after study conclusion.

Procedures

The study period ranged from January to September 2011. The main intervention of Ergo-JSI
was conducted between July and September 2011. Data was collected prior to the onset of the
intervention, and again 2 days following completion of the intervention. While the research was
being conducted, a total of 27 participants continued their banking routines and banking task as
usual. The workflow of this study is described in Figure 1. Prior to intervention, all individuals
(male and female workers) in the workplace (N=46) underwent MHACL and ECP questionnaire
surveys.
Focus group discussion

A focus group discussion (FGD), attended by the company management and one employee representative, was held in order to build commitment for the research and to finalize a detailed intervention plan suited to this particular workplace. The author (SP) led the FGD. Participants were divided into two groups, and were instructed to write down details of the problem(s) and suggested solutions using the 5 W’s and H (what, why, when, who, where, and how). Group representatives presented the group work, and a following discussion was concluded by feedback from the FGD leader and the management representatives. The FGD results shaped the following intervention and, along with results from the initial questionnaires, led to a decision to perform an intervention for eight weeks. The initial results also led to the conclusion that the focus of the intervention should be placed on better communication and support, the computer operator’s work posture and workstation, illumination, and information about health. Prior to the intervention, all study participants (N=27) were also subjected to the Brief Job Stress Questionnaire (BJSQ)\textsuperscript{29}, translated into Indonesian\textsuperscript{30}. Blood samples were taken and physical environment measures were performed as described below.

Blood cortisol

A blood sample was taken in association with the administration of the BJSQ. Trained nurses took the blood sample in the morning (at 8:00-8:30 am) in the workplace. Participants were only allowed to drink mineral water in the morning prior to the blood sampling. The blood cortisol was measured using a chemiluminescence technique at a certified clinical laboratory in Denpasar.
Physical environment measures

Physical environmental conditions were measured at eight locations in the workplace, and included the following parameters: Dry and wet temperature was measured using a sling thermometer (Bannan, England), and relative humidity was then calculated using a psychometric chart. Noise intensity was measured using a sound level meter (Lutron SAL, Japan), air movement was measured by anemometer (Lutron, Taiwan) and lighting conditions were measured by a lux meter (Lutron LM-800, Taiwan).

Intervention

Based on the results from the initial MHACL and Ergonomic Checkpoints surveys, along with the focus group discussion, the following intervention was tailored for the workplace.

Interventions targeting working conditions

(1) Task aspect: suboptimal banking software that introduced a risk of unsafe data management and banking practices was identified as a main factor contributing to employee stress. Hence, employees were given the opportunity to provide feedback and, thus, maximize the personal engagement in the continuous development of the electronic data processing (EDP) secure banking data system software. The intervention was supervised by EDP managers and created a more straightforward communication between the study participants and EDP department operators.

(2) Organizational aspect: as a means to increase job control, a continuous improvement program was initiated. The employees were given the opportunity to put forward any ideas to improve
working conditions. The data was then forwarded to the human resources (HR) department that
took action to implement the suggested changes in working conditions.

(3) Environmental aspect: following results of physical environment measurements, lighting was
improved by maximizing the natural light during daytime by keeping the curtains open,
repainting the tables from brown to a bright color, and adjusting the monitor position to avoid
glare, without obstructing the daylight entering through the window.

(4) Task aspect: Initial findings from the Ergonomics Check Point identified un-ergonomic work
postures (i.e. sitting without the use of back support and inadequate leg space). The work posture
of the employees performing computer work was improved using an onsite self-improvement
method. The employees were instructed to arrange the height of the chair so that the eye level
matched the top end of the monitor; remove unnecessary objects from under the desk to improve
leg space; use footrests for better leg blood circulation; and arrange the positions of the mouse
and keyboard to allow for a neutral wrist joint position and a position of the arms aligned to the
axis of body. A poster with instructions termed “Guidance for Office Ergonomics” was posted in
the work area to facilitate further referral to guidelines.

(5) Organizational aspect: 5-minute short breaks every two hours were arranged, along with
scheduled exercise in the workplace to reduce general fatigue while working at the computer.

Intervention targeting individual stress

The individual component of the intervention consisted of stress management training as
previously described. The training encompassed eight one-hour sessions, conducted every
Tuesday at the company meeting room, from 11.00 am to 12.00 am. Participants were divided
into five groups with five participants in each group. During each session, the participants first received a power point presentation and then continued working in groups using work sheets on the following specific topics: job stress mechanisms and effects (one session), job stress management in general (one session), ergonomics application to reduce stress (one session), cognitive restructuring (two sessions), time management (one session) and assertive skills (one session). The group work sheets were case based and each group representative presented the result of the group work during sessions. One session was spent as a summary and self-report of stress scores. Each session was divided into a 20-minute lecture, continued by group discussion based on the group work sheets. Work sheet presentations were preceded by a five-minute relaxation (mini progressive muscle relaxation). The participants were also provided with written material on stress management (pocket book and training material book) developed by the author30).

Post-intervention measurements

Two days following completion of the intervention, the participants were again subjected to the BJSQ, along with blood sampling. The physical environment measurements were also repeated following the completion of the intervention.

Statistical procedure

All data was analyzed using Statistical Package for the Social Sciences (SPSS) version 15.2, except the sample size calculation, which was performed using G*power32). A minimal sample size of $N=23$ was calculated based on an effect size of 0.6 ($\alpha=0.001$, $\beta=0.05$). Adding 20% resulted in a sample size of $N=27$. Sample characteristics were tabulated. To examine the
intervention effect, the change score of each variable between baseline and follow-up was
compared and tested with the paired t-test or Wilcoxon signed rank test. The choice of test was
performed following testing for normality of the data using the Kolmogorov-Smirnov test.
Physical environment data was also compared and similarly tested.

Results

Sample characteristics

Two participants did not complete the class training, and were, hence, excluded from further
participation in the study, leaving a total of 25 participants. All of the study participants were
male, with an average age of 39 years (SD = 6.1). A majority of the cohort, 76%, were Balinese,
88% had graduated from university, and 92% were married.

Ergonomic Check Points and Walk Through Survey

The layout of the work area and workstation was found un-ergonomic. Position of computer
monitor placement and design of the table lead an unnatural working posture, i.e. body position
was approximately at an angle of 30 degrees from desk due to inadequate leg space. Further,
workers were sitting without back support, and the angle of the head was 20 degrees caused by
low placement of monitors. Arms were stretched with the elbow away from the axis of the body.
Workers with short stature did not use a footrest for better leg position. Anthropometric
measurements showed the average knee high seating position was 57.16 cm (SD = 2.38), and the
size of leg space under the desk was 65.3 cm.
The walk-through survey revealed that there was confusion about the role of the workers, with no clear details of tasks and workflows. Workload was found high, with no adequate support systems present. Career opportunities for workers were not clearly communicated. In addition, task demands on workers dealing with monetary transactions were high in terms of accuracy processes combined with high working speed demands. The HR Department reported high employee absenteeism due to the pressure in the workplace. On average eight employees were absent due to sick leave for every two months. Medical expenses were Rp. 7.325 million between January and February 2011. The company covered 80% of treatment costs for employees.

**Job strain index**

The Cronbach’s alpha for the BJSQ was 0.79, indicating high reliability of the questionnaire. There was a significant difference in job strain index at baseline and following the intervention (Mean ± SD; 1.37 ± 0.29 vs. 0.92 ± 0.17, \( p < 0.05 \); Table 1). This is equivalent to a 33% decrease in job strain index in this study. During the intervention, no organizational or economic changes outside the scope of this research were implemented, hence, reducing the presence of confounding factors that might have affected the result.

**Psychological distress**

A significant difference in psychological distress before and after intervention was found (Mean ± SD; 37.60 ± 5.34 vs. 28.36 ± 6.76, \( p < 0.05 \); Table 1). This is equivalent to a 25% decrease in psychological distress.
None of the participants were smokers, and coffee intake was not allowed one day prior to blood sampling. Blood cortisol levels were significantly lower after the intervention (Mean ± SD; 13.03 ± 3.05 µg/dl vs. 9.94 ± 3.07 µg/dl, \( p < 0.05 \), Table 1), equivalent to a 24% decrease in cortisol levels.

The only parameter that changed significantly as a result of the intervention was illumination intensity (Mean ± SD; 287.8 ± 71.2 vs. 309.1 ± 149.1, \( p < 0.05 \), Table 2). Prior to the intervention, lighting in the work area ranged from 85 to 300 lux. All other conditions remained unchanged (Table 2).

The present work describes the theoretical framework and practical applications of a newly developed stress management intervention, the Ergo-JSI. The pilot study demonstrates that the program significantly improved the physical and psychosocial work environment and reduced stress among bank workers in Bali, Indonesia. The Ergo-JSI is a composite approach to workplace stress management, approaching stress from both an organizational and an individual standpoint. The program has its starting point in problem identification and discussion of potential solutions through a FGD, attended by a worker representative and management, hence, ensuring a participatory approach. The participatory approach was also used in scheduling the class management training. This approach was used to ensure the sustainability of the program.
A participatory approach assumes that people involved in the system (or program) can participate in, and otherwise contribute to, the design of a program that is useful, useable and enjoyable to them. To attempt to improve intervention results, the current study was an intervention at the organizational level in addition to an individually orientated approach. A previous study, conducted by Tsutzumi, used an intervention at the organizational level. The intervention was a single session supervisory education, using a participatory approach for workplace improvement. The study found favorable effects on worker mental health, performance, and well being. We further show that the individual-oriented part of the Ergo-JSI could enhance employee ability to cope with stress. Finally, and most importantly, the Ergo-JSI program reduced blood cortisol levels among the participants, providing an objective measurement of reduced stress. The favorable effects were measured immediately following the intervention. We measured cortisol in the morning before and after intervention (at the same time) to avoid diurnal variation of the hormone. Theoretically, humans have the highest levels of cortisol hormone in morning, dropping to lower levels in the afternoon. The higher morning hormonal levels make measurements more sensitive in identification of changes, compared to the detection of changes in the lower levels of hormone in the afternoon. The continuous improvement program (“kaizen” program) provided the employees with the opportunity to express ideas to improve their working conditions, with immediate implementation of feedback. The feedback provided by the department intended to offer emotional support to employees. This would have affected the psychosocial work environment, as well as the employees’ view on their organization. This kind of support is used as a strategy of emotion-focused coping. The present finding is consistent with a previous study showing that changes in work conditions could improve the psychosocial work environment.
environment\textsuperscript{20}. The Ergo-JSI program also included an intervention that intended to improve the ergonomics of the work posture, with an additional intervention in the form of exercise after sedentary work. It has been reported that a more ergonomic posture could minimize fatigue\textsuperscript{2,16,20}. Excessive physical fatigue and mental workload could lead to a negative irritable mood, hence increasing the risk of stress. Previous studies have found that it is possible to reduce job stress by designing work processes, or improving working conditions so that control over the job situation is increased\textsuperscript{7,18,28}. Results of cross-sectional and longitudinal studies are also consistently indicating that aerobic exercise training has antidepressant and anxiolytic effects and protects against harmful consequences of stress\textsuperscript{36}.

The Ergo-JSI also contains an individual-oriented component, composed of a stress-management training program. Part of this program handles communication skills, allowing the participants to feel more self-assured about the way they communicate. As a result, they feel more confident to tackle a potential stressor, which could influence their work performance, by means of verbal communication. Improved communication skills could, therefore, make participants more assertive and, hence, able to avoid personal or interpersonal conflicts that could potentially increase job strain and psychological distress\textsuperscript{17,37}. Improved communication skills could also be beneficial for participation in the work environment oriented part of the Ergo-JSI, as described above, since a large part of the process relied on participant feedback on their work situation. Another aspect of the individual stress management training aimed to affect individual core beliefs related to behavior and internal motivation. According to Borins, an intervention targeting the individual's core beliefs by using cognitive restructuring could influence an individual to change his/her mood to become more positive\textsuperscript{9,18}. This could potentially facilitate the handling of a job demand-related stressor through improved coping\textsuperscript{19}. It has been shown that a positive
change in behavior can depend on the learning situation and method used\textsuperscript{18, 34, 38}. In a meta-
analysis, Richardson and Rochstein found that cognitive and behavioral change of the
respondents had a major impact on handling work stress\textsuperscript{39}). This finding is also in line with the
results of Shimazu, who applied five sessions of stress management program to 24 teachers\textsuperscript{40}).

The Ergo-JSI successfully decreased the blood cortisol level among participants. Since the
program covers multiple strategies to decrease job stress, e.g., improving the working conditions
and enhancing individual skills in problem focus coping, it has the potential to affect employee
stress reactions including physiological responses along the HPA axis. This is in line with
Hansen and colleagues stated that one commonly suggested biological mechanism behind stress-
related poor health is the alteration in the activity of the hypothalamus pituitary adrenal axis\textsuperscript{41}). In
that study, participants learned to use emotion-focused coping (seeking emotional support from
the management) after obtaining feedback as a result of a continuous improvement program.
Problem-focused coping, in combination with emotion-focused coping were also associated with
the effects of lower stress reactions and increased performance\textsuperscript{42}). The present findings of a
measurable change in cortisol levels strengthens the results obtained through the BJSQ, as it
provides an objective measure of reduced stress in the participants. The findings in the present
study were also in line with two previous studies showing a significant decrease in blood cortisol
levels following stress management training\textsuperscript{14, 15}). According to Theorell, a significant interaction
effect was found for the level of serum cortisol; serum cortisol levels were decreased in the
intervention group (the group which was receive job stress management training) and were
\textit{unchanged} in the control group. The study indicated that a program lasting for one year could be
beneficial for the employees with regard to lowered serum cortisol\textsuperscript{14}). Although the current study
found a favorable effect of the intervention on cortisol levels, other studies report that the
association between cortisol and job strain are still contradictory\textsuperscript{41}). One study was unable to show a significant correlation between job strain and cortisol among workers in a mainly female sample, employed in human service organizations\textsuperscript{43}). Another study found that job strain was correlated with elevated cortisol concentrations early in the working day among male and female teachers\textsuperscript{44}). Luecken also noted that cortisol levels measured during the working day in a sample of women were unrelated to job strain but were greater among those reporting high strain at home due to domestic responsibilities\textsuperscript{45}). Perceived stress among male and female teachers was found to correlate with increased cortisol levels during the first hour after awakening\textsuperscript{46}). The link between cortisol levels and work related stress, therefore, need to be further assessed in future studies. Nevertheless, the observed effect of lowered job-stress index following the Ergo-JSI could be attributed to the fact that Ergo-JSI is a composite intervention program, including both organizational, work environment aspects and individual-oriented aspects targeting cognitive processes in the employee. Integrated interventions similar to Ergo-JSI are not common, and direct comparisons to previous intervention studies are hampered by the use of different outcome measures. A study by Umanodan, who employed a stress management program without concomitant ergonomic or task improvement, showed a reduction in psychological distress by 8\%\textsuperscript{47}). Considering the small sample size of the present study, it is possible that the comparatively large change observed here might be an overestimation due to selection bias. However, it is also possible that the composite approach presented here is more efficient in reducing psychological distress compared to the use of a stress management education only. It has to be noted however that several other studies failed to show an effect on psychological distress following stress management interventions in the form of only individual based approaches\textsuperscript{46}).
The present study suffered a number of limitations. The study employed a small number of participants in a single group pre- and post-test study design, performed in only one location. Given this study design, a Hawthorne effect might have influenced the study results. The dynamics and specific problems related to a particular workplace will also naturally differ between workplaces. Moreover, although the study participants were randomly selected from the total number of employees in the workplace, the study likely suffers from selection bias, and the participants might not be representative of the general population. Another factor limiting the scope of the study is the lack of long-term follow up data, supporting the intervention’s feasibility. Nevertheless, the participatory approach employed in this study has previously been shown to make interventions more sustainable\textsuperscript{16, 34}. A high commitment to the study among the management personnel might also contribute to sustainability. Nonetheless, future studies investigating potential benefits of Ergo-JSI need to include follow up at later time points to assure the sustainability of the intervention. To avoid potential confounding induced by hormonal fluctuations during the menstrual cycle, the present study focused only on male employees. Females tend to suffer higher stress reactions and negative mood associated with the premenstrual period\textsuperscript{12}. Women’s menstrual cycle may influence them both physically and mentally, and might also influence cortisol levels\textsuperscript{48}. This condition creates character differences among women that could affect their performance and emotional state\textsuperscript{49}. Weighing in hormonal contribution to stress reactions and cortisol levels could present a more complex scenario, which is beyond the scope of this study to address. Expanding this research in a randomized control trial is crucial to confirm the evidence presented here. Furthermore, it is necessary to perform follow-up measurements investigating the long-term effects of the intervention, and also to investigate other biological parameters of the stress reaction to confirm the beneficial effect of
Ergo-JSI on work related stress. Despite the limitations mentioned above, this study offers potential implications or benefits in giving algorithm guidance in ergonomics based job stress management programs for male office workers. The study outlines the necessary steps – or algorithm – of a job stress management program in a real-life setting. Other strengths of this study are the included steps of problem identification – combining the Ergonomics Check Point and Mental Health Action Check List followed by FGD. The attempts to find solutions using a participatory approach, along with the combination of ergonomics applications with individually orientated job stress management, provide benefits that should be explored in future studies.

Conclusion

In conclusion, the present study shows that the application of the newly developed stress management intervention program, Ergo-JSI, to a National Private Bank in Denpasar, Bali, Indonesia, had a number of beneficial outcomes. Following the intervention, participants displayed a 46% decrease in the job strain index, a 28% decrease in psychological distress, accompanied by a 24% decrease in blood cortisol levels. This indicates that the Ergo-JSI, with its integrative approach, is effective in improving psychosocial and psychological factors related to workplace dynamics and hence in the reduction of work related stress.

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References


Table 1. Job strain index, cortisol and psychological distress at baseline and follow up after the Ergo-JSI intervention.

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<td>Mean</td>
<td>SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Job strain index</td>
<td>1.37</td>
<td>0.29</td>
<td>0.92</td>
<td>0.17</td>
<td>9.108</td>
<td>0.05b</td>
</tr>
<tr>
<td>Psychological distress</td>
<td>37.60</td>
<td>5.34</td>
<td>28.36</td>
<td>6.76</td>
<td>-3.991</td>
<td>0.05b</td>
</tr>
<tr>
<td>Blood cortisol (µg/dl)</td>
<td>13.03</td>
<td>3.05</td>
<td>9.94</td>
<td>3.07</td>
<td>4.520</td>
<td>0.05a</td>
</tr>
</tbody>
</table>

a = Wilcoxon signed rank test
b = Paired t-test
Table 2. Physical work environment conditions at a National Bank in Denpasar Bali before and after the intervention of Ergo-JSI, measured at 8 positions in the workplace.

<table>
<thead>
<tr>
<th>No.</th>
<th>Variable</th>
<th>Baseline</th>
<th>Follow-up</th>
<th>t or z</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Average</td>
<td>Average</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>SD</td>
<td>SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Wet temperature (°C)</td>
<td>19.2</td>
<td>19.2</td>
<td>0.00</td>
<td>1.00a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.4</td>
<td>0.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Dry temperature (°C)</td>
<td>25.1</td>
<td>25.1</td>
<td>-1.86</td>
<td>0.06a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.04</td>
<td>0.1</td>
<td></td>
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<tr>
<td>3.</td>
<td>Relative humidity (%)</td>
<td>61.0</td>
<td>60.8</td>
<td>-1.00</td>
<td>0.32a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.2</td>
<td>0.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Noise intensity (dBA)</td>
<td>66.6</td>
<td>66.1</td>
<td>-1.39</td>
<td>0.16a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.5</td>
<td>1.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Air movement (m/sec)</td>
<td>0.2</td>
<td>0.2</td>
<td>0.00</td>
<td>1.00a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.01</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Lighting intensity (lux)</td>
<td>287.8</td>
<td>309.1</td>
<td>-4.20</td>
<td>&lt;0.01b</td>
</tr>
<tr>
<td></td>
<td></td>
<td>71.2</td>
<td>149.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a = Wilcoxon singed rank test
b = Paired t-test
Figure 1. Workflow of the study.

MHACL & ECP surveys (N=50) → Focus group discussion →
Brief Job Stress Questionnaire (N=27) → Blood Sampling (N=27) →
Intervention (N=25) →
Brief Job Stress Questionnaire (N=25) → Blood Sampling (N=25)