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Can high social capital at the workplace buffer against stress and musculoskeletal pain?
Cross-sectional study
Kenneth Jay, MSc, PhD\textsuperscript{a,b,*}, Lars L. Andersen, PhD\textsuperscript{a,c}

Abstract
Work-related musculoskeletal pain and stress are both highly prevalent in the working environment and relate well to the biopsychosocial model. While the onset of musculoskeletal pain is often dependent on the biological element of the biopsychosocial model, chronic pain is often influenced by psychological and social factors. Similarly, stress is also influenced by biological, psychological, and social factors. This study investigates the possibility of social capital being a buffer for stress and musculoskeletal pain in a group of female laboratory technicians.

Female laboratory technicians (n=500) replied to questions about stress (Cohens Perceived Stress Scale-10), musculoskeletal pain (0–10 visual analog scale), and social capital at the workplace (bonding [in teams], bridging [between teams], and linking [between teams and leaders]). Outcome variables were stress and musculoskeletal pain and the predictor variable was social capital. General linear models tested the association of the 3 types of social capital (predictor variables) with stress and pain (mutually adjusted outcome variables). Analyses were controlled for age, lifestyle (body mass index, smoking), seniority, and working hours per week.

For stress as outcome, moderate and high bonding social capital were different from low social capital with $-2.04 \ (95\% \ CI \ = -3.33 \text{ to } -0.76)$ and $-4.56 \ (95\% \ CI \ = -5.84 \text{ to } -3.28)$ points on the Perceived Stress Scale of 0 to 42, respectively. Similarly, moderate and high bridging social capital were different from low social capital with $-1.50 \ (95\% \ CI \ = -2.76 \text{ to } -0.24)$ and $-4.39 \ (95\% \ CI \ = -5.75 \text{ to } -3.03)$, respectively. For linking, only high social capital was significantly different from low with $-2.94 \ (95\% \ CI \ = -4.28 \text{ to } -1.60)$. None of the 3 types of social capital was associated with musculoskeletal pain.

Higher levels of social capital at the workplace appear to buffer against stress, but not against musculoskeletal pain. Intervention studies should investigate whether improving bonding, bridging, and linking social capital at the workplace may be a viable strategy to prevent or reduce work-related stress.

Abbreviations: BMI = body mass index, IRMA = implementation of physical exercise at the workplace, PSS = Perceived Stress Scale, PSS-10 = Perceived Stress Scale 10 item questionnaire, VAS = visual analog scale.

Keywords: biopsychosocial, bonding, bridging, laboratory technicians, linking, pain, stress, work environment

1. Introduction
The value of social networks is the central premise of social capital. For instance, Putnam defines social capital as “features of social organization such as networks, norms, and social trust that facilitate coordination and cooperation for mutual benefit”\textsuperscript{[1]} and Nahapiet and Ghoshal define social capital as: “the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit. Social capital thus comprises both the network and the assets that may be mobilized through that network,”\textsuperscript{[2]} while Coleman defines it as: “Social capital is defined by its function. It is not a single entity, but a variety of different entities having two characteristics in common: They all consist of some aspect of social structure, and they facilitate certain actions of individuals who are within the structure.”\textsuperscript{[3]} By these definitions, social capital can therefore best be described as referring to the collective value of all “social networks” and the “norms of reciprocity” that arise from these networks. Social capital describes a variety of specific benefits that flow from the trust, reciprocity, information, and cooperation associated therewith, thus creating value and productive benefits for the people connected. By these definitions, a high social capital seems like something that should be an inherent part of a healthy environment at modern workplaces.

In relation to workplace research, 3 main types of social capital exist.\textsuperscript{[4,5]} The first is social capital within working teams (bonding) and represents working relationships within the team or group, for example, agreeing about what is important and a feeling of unity and cohesion in the team. The second is social capital between working teams (bridging) and represents working relationships between different teams or groups, for example, having trust in the ability of the other team to do the
task well. The third is social capital between teams and leaders (linking) and represents working relationships between the members of the team or group and their leader, for example, to what degree does the leader understand and acknowledge the work of the group and whether there is a common understanding between the leader and members of the group about how to perform the work. While all 3 types are important, they represent different aspects of social capital and can respond differently to interventions at the workplace. For example, we have recently found improved bonding social capital in response to group-based physical exercise at the workplace in spite of a general decrease in linking social capital.14

Work-related stress arising from low job control and high job demands have been shown to be associated with adverse health outcomes such as hypertension and other health-risk behaviors.16 Underlying conditions of stress cross both physical/biological and psychological barriers when an organism is strained beyond its power to adapt. From a physical perspective, stress has been explained as a mechanical and automatic response from the human body and a similar response occurs when the threat has psychological characteristics.17 The human body has an innate drive to maintain a biological equilibrium. Stressors such as pain, sickness, or excessive physical or psychosocial work demands disrupt the homeostasis and trigger a natural response from the body, aimed at returning it to homeostasis. Briefly, the natural response can be described as a tri-phasic phenomenon. The first phase is an alarm phase representing a somatic shock followed by the second phase being a resistance to this shock where the body will fight the alarming threat and work its way back to homeostatic equilibrium. The first 2 stages are repeated throughout an individual’s life as the person faces new challenges and obstacles. However, should the body remain in the second stage for prolonged periods of time, the body may enter the exhaustion stage. Models of the exhaustion stage indicate that it is the inability to adapt to the causing stressors or to an extended duration of time being subjected to the stressors that create the symptoms describing the stress state.7–12 The proposed model by Cooper and Marshall of work-related stress describes 5 sources of stress, each with the possibility of disrupting homeostatic equilibrium for an extended period leading to the exhaustion phase: intrinsic to the job, including factors such as poor physical working conditions, work overload, or time pressures; role in the organization, including role ambiguity and role conflict; career development, including lack of job security and under/over promotion; relationships at work, including poor relationships with the boss or colleagues, an extreme component of which is bullying in the workplace; and organizational structure and climate, including little involvement in decision-making and office politics.13 Combined, these stressors describe a biopsychosocial relationship in the development of work-related stress where perceived social interactions were social cohesion, trust, reciprocity, and cooperation in the workplace.11 affects health outcomes, such as pain,16 health-risk behaviors,17 depression,18 and even mortality.20 In addition to stress, musculoskeletal pain is also a major work-related challenge. Work-related pain plays a dominating role in work environment and health.21,22 It is a major socioeconomic burden with consequences for both the individual, the social relations of the individual, and the organization.23 Musculoskeletal pain is one of the most common causes for loss of productivity, reduced work performance, and sickness absence.23 In addition, chronic pain has been associated with poor quality of life.26–28

2. Methods

2.1. Study design

This study is an explorative cross-sectional analysis of baseline data obtained during a worksite intervention trial previously described by our research team.29–31,39,40 Data for this study were collected during the spring of 2014. A protocol of the study and primary, secondary, and tertiary outcomes, together with a cross-sectional study of work ability, have all been reported previously.29–31,39,40

2.2. Ethical approval

Ethical approval was obtained from the Danish National Committee on Biomedical Research Ethics (the local ethical committee of Frederiksberg and Copenhagen; H-3-2010-062) as part of the research program “Implementation of physical exercise at the workplace (IRMA).” The trial “Implementation of physical exercise at the Workplace (IRMA09)—Laboratory technicians” was registered in the ClinicalTrials.gov register (NCT02047669) prior to participant enrolment. All experimental conditions conformed to the Declaration of Helsinki. All reporting conforms to the STROBE guidelines “Strengthening the Reporting of Observational Studies in Epidemiology.”

2.3. Participants

Out of 756 laboratory technicians at a large pharmaceutical company in Denmark, 539 completed questionnaires on musculoskeletal pain, perceived level of stress, and social capital. Of these, 473 were women and included in the analysis. Table 1 shows participant demographics of relevant data. All eligible participants were informed about the purpose and content of the study. Table 1 shows participant characteristics of relevant data.

2.4. Outcome variables

2.4.1. Stress. The Perceived Stress Scale (PSS) is a comprehensive stress questionnaire and was designed to measure “the degree to which individuals appraise situations in their lives as stressful.”
2.5. Predictor variables: Bonding, bridging, and linking

Female workers (n=473) replied to a baseline screening questionnaire concerning Bonding, Bridging, and Linking (A+B) social capital.\textsuperscript{4,5} Two sample questions out of 9 questions for bonding social capital are “In our team, we agree on what is the most important in our work tasks” and “There is a feeling of unity and cohesion in my team.” Two sample questions of a total of 6 for bridging social capital are “Is there a good working relationship between your team and the other teams/departments?” and “We have trust in the ability of the other teams to do the job well.” Two sample questions out of 10 questions for linking social capital are “Do your nearest leader contributes to solving everyday problems?” “Our nearest leader has great knowledge and understanding of the work we do,” “Are the employees involved in decisions about changes at the workplace?” and “There is a common understanding between the management and employees on how we should perform our work tasks.” Participants replied on a horizontally oriented scale of 0 to 10, where 0 is “no, not at all” and 10 is “Yes, completely.” For each of the social capital dimensions, the average value of all questions was calculated and multiplied by 10 (i.e., 0–100) to provide a higher resolution of the respective social capital dimension.\textsuperscript{43} The cut points between low, moderate, and high social capital in bonding, bridging, and linking were chosen to have as close as 33.3% of the subjects in each group—in teams, low social capital (0–69), moderate social capital (69–85), and high social capital (85–100); between teams: low social capital (0–66), moderate social capital (66–80), and high social capital (80–100); and between teams and leader/management: low social capital (0–69), moderate social capital (69–82), and high social capital (82–100).

2.6. Statistics

General linear models (Proc GLM, SAS version 9.4) tested the association of the 3 types of social capital (predictor variables) with stress and pain (mutually adjusted outcome variables). Analyses were controlled for age, lifestyle (body mass index [BMI], smoking), seniority, and working hours per week. Stress analysis was controlled for pain, and pain analysis was similarly controlled for stress. Results are reported as least square means and 95% confidence intervals (CIs), as well as between-group differences of least square means and 95% CIs. In addition, effect sizes (Cohen’s d) were calculated as the between-group difference (high vs. low, and moderate vs. low) divided by the pooled standard deviation.\textsuperscript{46} According to Cohen, effect sizes of 0.20, 0.50, and 0.80 can be considered small, moderate, and large, respectively.

3. Results

For stress as outcome, moderate and high social capitals in teams are both statistically different from low social capital with effect sizes of 0.32 and 0.71, respectively. A similar picture is seen with social capital between teams where moderate and high social capitals are statistically different from low social capital with effect sizes of 0.23 and 0.69, respectively. For social capital between team and leader/management, only high social capital buffers against stress compared with low social capital with an
Social capital between team and leader (linking)
Social capital between teams (bridging)
Social capital between team and leader (linking)
Social capital between teams (Bridging)
Social capital in teams (bonding)

Pain and social capital.
Stress and social capital.

Table 2
Stress and social capital.

<table>
<thead>
<tr>
<th>Social capital in teams (bonding)</th>
<th>Stress</th>
<th>Difference from low social capital (95% CI)</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>14.83  (13.70–15.97)</td>
<td>−2.04 (−3.33 to −0.76)</td>
<td>0.32</td>
</tr>
<tr>
<td>Moderate</td>
<td>12.79  (11.63–13.96)</td>
<td>−4.56 (−5.84 to −3.28)</td>
<td>0.71</td>
</tr>
<tr>
<td>High</td>
<td>10.27  (9.11–11.43)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Social capital between teams (bridging)

<table>
<thead>
<tr>
<th>Social capital between teams (bridging)</th>
<th>Stress</th>
<th>Difference from low social capital (95% CI)</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>14.45  (13.30–15.60)</td>
<td>−1.50 (−2.76 to −0.24)</td>
<td>0.23</td>
</tr>
<tr>
<td>Moderate</td>
<td>12.95  (11.84–14.07)</td>
<td>−4.39 (−5.76 to −3.03)</td>
<td>0.69</td>
</tr>
<tr>
<td>High</td>
<td>10.05  (8.82–11.29)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Social capital between team and leader (linking)

<table>
<thead>
<tr>
<th>Social capital between team and leader (linking)</th>
<th>Stress</th>
<th>Difference from low social capital (95% CI)</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>13.74  (12.54–14.94)</td>
<td>−0.39 (−1.71 to −0.92)</td>
<td>0.06</td>
</tr>
<tr>
<td>Moderate</td>
<td>13.35  (12.16–14.53)</td>
<td>−2.94 (−4.28 to −1.60)</td>
<td>0.46</td>
</tr>
<tr>
<td>High</td>
<td>10.80  (9.60–12.00)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Stress in relation to social capital in teams, between teams, and between the team and leaders. Controlled for age, lifestyle (body mass index, smoking), seniority, working hours per week, and musculoskeletal pain. CI = confidence interval.

Effect size of 0.46. With musculoskeletal pain as outcome neither moderate or high social capital in bonding, bridging, or linking buffers against musculoskeletal pain compared with low social capital. Full results on social capital as buffer against stress and pain are shown in Tables 2 and 3, respectively. Thus, social capital appears to buffer against stress but not musculoskeletal pain.

4. Discussion

The present cross-sectional analysis of approximately 500 female laboratory technicians shows that having both moderate and high social capital in bonding, bridging, or linking buffers against musculoskeletal pain compared with low social capital. Full results on social capital as buffer against stress and pain are shown in Tables 2 and 3, respectively. Thus, social capital appears to buffer against stress but not musculoskeletal pain.

Table 3
Pain and social capital.

<table>
<thead>
<tr>
<th>Social capital in teams (bonding)</th>
<th>Musculoskeletal pain</th>
<th>Difference from low social capital (95% CI)</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>1.78 (1.49–2.07)</td>
<td>−0.11 (−0.44 to 0.21)</td>
<td>0.08</td>
</tr>
<tr>
<td>Moderate</td>
<td>1.66 (1.37–1.95)</td>
<td>0.22 (−0.11 to 0.55)</td>
<td>−0.15</td>
</tr>
<tr>
<td>High</td>
<td>2.00 (1.71–2.29)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Social capital between teams (Bridging)

<table>
<thead>
<tr>
<th>Social capital between teams (Bridging)</th>
<th>Musculoskeletal pain</th>
<th>Difference from low social capital (95% CI)</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>1.80 (1.51–2.09)</td>
<td>−0.11 (−0.42 to 0.20)</td>
<td>0.07</td>
</tr>
<tr>
<td>Moderate</td>
<td>1.69 (1.42–1.97)</td>
<td>0.21 (−0.14 to 0.56)</td>
<td>−0.14</td>
</tr>
<tr>
<td>High</td>
<td>2.01 (1.70–2.32)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Social capital between team and leader (linking)

<table>
<thead>
<tr>
<th>Social capital between team and leader (linking)</th>
<th>Musculoskeletal pain</th>
<th>Difference from low social capital (95% CI)</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>1.82 (1.53–2.11)</td>
<td>−0.13 (−0.44 to 0.19)</td>
<td>0.08</td>
</tr>
<tr>
<td>Moderate</td>
<td>1.69 (1.41–1.98)</td>
<td>0.16 (−0.17 to 0.49)</td>
<td>−0.11</td>
</tr>
<tr>
<td>High</td>
<td>1.98 (1.69–2.27)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Musculoskeletal pain in relation to social capital in teams, between teams, and between the team and leaders. Controlled for age, lifestyle (body mass index, smoking), seniority, working hours per week, and stress. CI = confidence interval.
suggests that focusing on improving social capital can be beneficial in persons with chronic pain, this study suggests that having moderate or high social capital does not act as a buffer against musculoskeletal pain. Therefore, increasing social capital as a preventive measure of work-related musculoskeletal pain development alone may not be a feasible strategy but should still be considered for rehabilitation purposes. Conversely, this study does suggest that having moderate or high social capital does buffer against stress. This perspective is interesting as it implies an important aspect of work health and it supports both the psychological and social elements of the biopsychosocial model as described by Engel in 1977[14,15] and since stress can be described as either the reaction (psychological, physiological, and behavioral) to environmental stimuli or the interaction between environmental characteristics and the subjective reaction to these characteristics,[31,49] improving social capital at the worksite appears to be a viable strategy to implement when the goal is to buffer against work stress. This is supported by the findings of Boyas and Wind who, in a cross-sectional study, examined the relationship between employment-based social capital, job stress, and burnout among public child welfare workers and found that communication, supervisory support, organizational commitment, influence, and trust—all elements of social capital—had a significant association with job stress.[10] Furthermore, Gächter et al, found, by analyzing survey data from police officers to assess the relationship between stress, strain, and social capital, that an increase in social capital is significantly correlated to a decrease in perceived level of strain and psychological burnout, thus recommending that stress reduction programs should actively engage employees to build stronger social relations and networks.[51]

Although all 3 types of social capitals buffered against perceived stress, social capital in and between teams appeared to be more important than social capital between leaders and teams, that is, both moderate and high levels of social capital were important. Thus, factors such as agreeing on what is the most important in daily work tasks and a feeling of unity and cohesion in the team seem to be important within the teams, while good working relationships and trusting other teams seem to be important between teams. By contrast, only high social capital, and not moderate social capital, between teams and leaders were important for lower levels of perceived stress. The perceived high level of contribution from the leader to solve everyday problems, a great knowledge and understanding of the work that the employees do, involving employees in decisions about changes at the workplace, and having a common understanding about what is expected are important factors between leaders and teams in relation to lower levels of stress.

4.1. Strengths and limitations

This study demonstrates that moderate and high social capital buffers against work stress but not against musculoskeletal pain. However, the study has some important limitations. The cross-sectional design does not allow examination of causal associations. Although the sample size is adequate to test the research question, self-reported data are a limitation as they may be influenced by subjective factors. Finally, given the demographic characteristics of this sample (Danish female laboratory technicians), generalizability to other job groups, to men, and to other countries remain to be determined. Contrariwise, using a homogenous sample consisting of female laboratory technicians is also a noteworthy strength, as it limits bias from socioeconomic confounding. Finally, because social capital deals with human behavior, the study could have been strengthened by qualitative interviews to supplement the questionnaire replies.

In conclusion, this study provides an interesting perspective in factors that may be important in stress prevention and management at the worksite. Our results indicate that having moderate and high social capital buffer against stress. Intervention studies should test whether improving social capital in bonding, bridging, and linking may be a viable strategy to implement in a time where work-related stress is highly prevalent and a socioeconomic burden of considerable size.

**Author contributions**

**Conceptualization:** K. Jay, L.L. Andersen.

**Data curation:** K. Jay, L.L. Andersen.

**Project administration:** K. Jay.

**Writing – original draft:** K. Jay.

**Writing – review & editing:** K. Jay, L.L. Andersen.

**Formal analysis:** L.L. Andersen.

**Supervision:** L.L. Andersen.

**References**


