EFFECT OF MICRO-BREAKS AND STRETCHING EXERCISES ON MUSCULOSKELETAL PAIN AMONG SCHOOL TEACHERS

An Experimental Study

[1]Madiha Samir Kazi, [2]Dr. Rutuja Kowale (PT), [3]Dr. Chandra Iyer (PT)

[1]Bachelor of Physiotherapy, [2]Professor and research guide, [3]Professor
[1,2,3]Department of Physiotherapy,
[1,2,3]TMV's Jayantrao Tilak College of Physiotherapy, Tilak Maharashtra Vidyapeeth, Pune, India

Abstract : Musculoskeletal disorders are a leading occupational health concern, and teaching, with its long spells of standing, board writing and bending over notebooks, keeps the neck, back and limbs under constant load. This study examined whether short work-time rest pauses combined with stretching can reduce pain in school teachers. A single-group, pre-test–post-test experimental study was carried out over six months in 50 school teachers (mean age 46.80 ± 6.28 years; 88% women) who reported musculoskeletal discomfort and were enrolled by convenience sampling. The Nordic Musculoskeletal Questionnaire identified symptomatic regions, and the Numeric Pain Rating Scale (NPRS) recorded pain in nine body regions before and after the programme. Participants took 2–3-minute micro-breaks at regular intervals during the school day and used them to stretch the neck, shoulders, back and upper limbs. Scores were compared with the Wilcoxon signed-rank test (significance, $p < 0.05$). Mean NPRS scores fell in every region, and every fall was statistically significant. The lower back showed the largest absolute drop (4.00 to 2.14), and the pain score averaged over the nine regions declined by 47.9% (1.98 to 1.03; $z = -6.16$, $p < 0.001$), with all 50 teachers improving. Severe pain, recorded 32 times across regions at baseline, was absent afterwards. A low-cost programme of micro-breaks with stretching reduced musculoskeletal pain in these teachers and may be offered as a preventive physiotherapy measure in schools, although the absence of a control group calls for cautious causal interpretation.

IndexTerms **- Micro-breaks, stretching exercises, musculoskeletal pain, school teachers, Numeric Pain Rating Scale, Nordic Musculoskeletal Questionnaire.**

I. INTRODUCTION

Work-related musculoskeletal disorders (MSDs) are among the commonest occupational health problems. They cover painful and often degenerative conditions of muscles, tendons, ligaments, joints and nerves that show up as pain, stiffness, fatigue and loss of function. The World Health Organization estimates that about 1.71 billion people worldwide live with a musculoskeletal condition, and that these conditions are a major source of disability in working-age adults [1].

Teaching is a physically repetitive occupation. A school day involves standing through lessons, writing on boards with raised arms, bending the neck over notebooks and sitting at a computer for planning and paperwork. Prolonged standing and awkward postures have been identified as key risk factors for neck, shoulder and low back pain in school teachers [2]. In a survey of 369 university faculty members, 92.6% reported pain in at least one body region during the previous year, and the shoulders (69.1%), neck (66.9%) and lower back (59.3%) were affected most often; stress, poor posture, repetitive movement and female sex predicted pain, and pain was linked to continuing to work while unwell [3]. In teaching staff, back pain has likewise been related to workstation ergonomics and to the habit of taking physical activity breaks during work [4].

Static work is thought to hurt partly because sustained low-level contraction compresses the small vessels inside muscle, limiting blood flow and oxygen delivery and letting metabolic by-products such as lactate accumulate and sensitise nociceptors. In static postures the same low-threshold motor units are recruited continuously and get little chance to recover, an idea known as the Cinderella hypothesis. Over time this strain may lead to soft-tissue microtrauma, joint irritation and lasting fatigue, with knock-on effects on concentration, teaching quality, job satisfaction and attendance.

Workplace prevention increasingly relies on micro-breaks, which are brief and frequent pauses taken during working hours to interrupt static loading, restore circulation and sustain alertness, and on stretching, which eases muscle tightness, improves joint mobility and helps restore neuromuscular balance. An eight-week active-break programme reduced neck, low back and overall discomfort in office workers [5]; a meta-analysis found that workplace micro-exercises lasting 2–15 minutes lessened neck and shoulder pain and neck disability [6]; and stretching has been linked to fewer complaints among construction workers [7] and, together with ergonomic changes, to less discomfort in office staff [8].

Such measures are rarely built into school routines. Teachers receive little ergonomic training, timetables seldom include movement pauses, and trials of a combined micro-break and stretching programme in school teachers, particularly in India, are scarce. This gap limits the evidence available for ergonomic and occupational health guidance in schools. The present study was

therefore designed to test whether a simple, school-based programme of micro-breaks and stretching can reduce musculoskeletal pain in teachers.

A. Aim and objectives

The aim was to evaluate the effect of micro-breaks and stretching exercises on musculoskeletal pain among school teachers. The objectives were (i) to screen for musculoskeletal symptoms with the Nordic Musculoskeletal Questionnaire (NMQ); (ii) to measure pain intensity in nine body regions before and after the intervention with the NPRS; (iii) to determine the effect of the programme on pain; and (iv) to identify the body regions most often affected.

B. Hypotheses

The null hypothesis (H_0) stated that the programme would produce no significant change in musculoskeletal pain. The alternative hypothesis (H_1) stated that micro-breaks with stretching would significantly reduce musculoskeletal discomfort among school teachers.

II. Review Of Literature

Rabal-Pelay et al. [5] placed 31 full-time office workers on an eight-week active-break programme (two video-led 15-minute sessions a week of stretching, mobility and body-weight exercises; mean adherence 82%). Discomfort scores fell significantly for the neck, lower back and whole body, whereas perceived stress did not change significantly in the group as a whole. A systematic review and meta-analysis by Yaghoubitajani et al. [6] pooled studies of workplace micro-exercises lasting roughly 2–15 minutes and reported clinically meaningful reductions in neck and shoulder pain, neck disability and overall body strain among sedentary workers. Prihanto et al. [7] followed 76 construction workers in a quasi-experimental design and found fewer musculoskeletal complaints after a workplace stretching programme ($p < 0.05$); younger age, better posture, shorter work duration and lighter workload were also associated with fewer complaints. In a randomised trial, Shariat et al. [8] found that stretching training with ergonomic modifications lowered discomfort in office workers.

Descriptive studies show how common the problem is among educators. Elkholi et al. [3] found that 92.6% of 369 faculty members had pain in at least one region over the previous year and 74% in the previous week, with the shoulders, neck and lower back most affected; stress, uncomfortable posture, female sex, obesity and repetitive movement predicted pain, which was linked to reduced work functioning and presenteeism but not to absenteeism. Galof and Šuc [4] surveyed teaching staff of a health-sciences faculty and reported that back pain correlated with daily computer use, head, shoulder and leg positions, screen inclination, chair adjustment, eye–screen distance and physical activity breaks at work ($r = 0.443$ to 0.766), concluding that even teachers trained in health sciences underestimate the effect of a poorly designed work environment.

Taken together, the literature shows that musculoskeletal pain is common in teachers and academic staff, that active breaks and stretching can ease neck, shoulder and back symptoms in other occupations, and that ergonomic habits and activity breaks are related to back pain in teaching staff. What is missing is a study of combined micro-breaks and stretching in school teachers, which the present work addresses.

III. Materials And Methods

A. Design, setting and participants

A single-group, pre-test–post-test experimental design was used. Teachers were recruited at their schools by convenience sampling during a six-month study period, giving a sample of 50. Eligible teachers were aged 35–55 years, had at least 3–4 years of teaching experience, reported musculoskeletal discomfort in any body region and gave informed consent. Teachers with a recent fracture or surgery, or with a diagnosed neurological or systemic disorder, were excluded.

B. Outcome measures

Symptoms were screened with the standardised Nordic Musculoskeletal Questionnaire [9], which records, for nine body regions (neck, shoulders, upper back, elbows, wrists/hands, lower back, hips/thighs, knees and ankles/feet), whether ache, pain or discomfort occurred in the previous 12 months, whether it prevented normal activity, and whether it was present in the previous 7 days. Pain intensity in each region was rated on the 11-point Numeric Pain Rating Scale (NPRS; 0 = no pain, 10 = worst possible pain), a simple, valid and responsive measure [10]. For categorical summaries, scores were grouped as no pain (0), mild (1–3), moderate (4–6) and severe (7–10). The materials used were questionnaires, stretching charts or posters, a stopwatch and consent forms.

C. Procedure

After approval from the Institutional Ethics Committee and permission from the school authorities, eligible teachers were approached at their schools. The purpose and procedure were explained, and written informed consent and demographic details were collected (Fig. 1). Baseline NMQ and NPRS assessments were then completed. Participants were taught how and when to take micro-breaks, adherence was checked through supervision and self-reporting, and the NMQ and NPRS were repeated at the end of the intervention period.

D. Intervention

Participants took active pauses of 2–3 minutes at regular intervals during working hours, stepping away from the posture of the task in hand (standing at the board, bending over notebooks or sitting at a computer) to carry out the stretching routine listed in Table 1. Stretches were performed slowly to a mild pulling sensation and never into pain, with normal breathing and no bouncing. Charts or posters guided the exercises, and a stopwatch was used for timing.

E. Ethical considerations

Approval was obtained from the Institutional Ethics Committee and the school authorities before the study began. Participants were told about the purpose, procedure and voluntary nature of the study, gave written consent, were assured of confidentiality and could withdraw at any stage without penalty.

F. Statistical analysis

Data were entered in Microsoft Excel and analysed with statistical software. Demographic data are given as frequencies, percentages, means and standard deviations. Because the NPRS is an ordinal scale and the scores were not normally distributed, pre- and post-intervention scores were compared with the Wilcoxon signed-rank test [11], using the normal approximation (z) with correction for tied ranks. Percentage reduction was calculated as (pre-intervention mean − post-intervention mean) / pre-intervention mean × 100. The level of significance was set at $p < 0.05$.

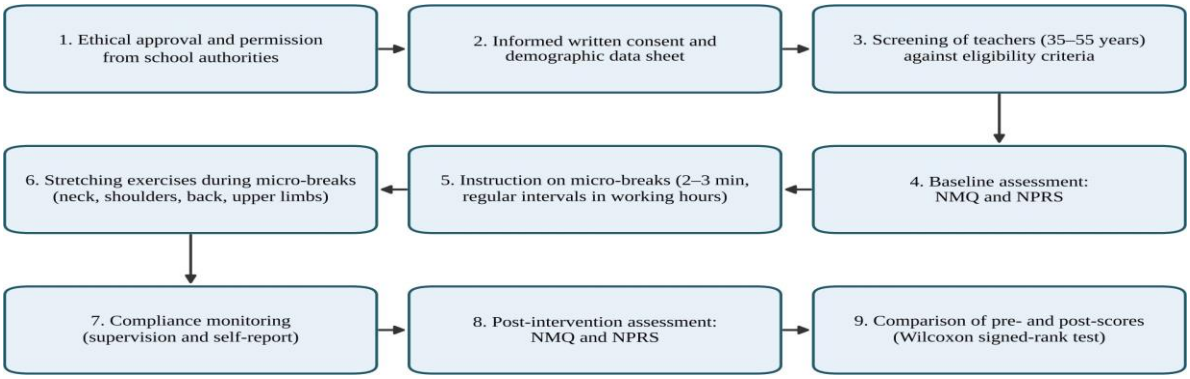

Fig. 1: flow of the study procedure (NMQ, Nordic Musculoskeletal Questionnaire; NPRS, Numeric Pain Rating Scale).

Table 1: stretching routine performed during the micro-breaks

Region	Exercise	Technique
Neck	Neck flexion	From a tall sitting or standing position, lower the chin towards the chest, hold, and return to neutral.
	Neck extension	Tilt the head back slowly within a comfortable range, hold, and return to neutral.
	Lateral neck flexion	Bring one ear towards the same-side shoulder, with light hand assistance if desired, hold, and repeat on the other side.
Shoulders and upper back	Cross-body stretch	Draw one arm across the chest with the opposite hand, hold, and change sides.
	Triceps stretch	Lift one arm and bend the elbow so the hand falls behind the head; press gently on the elbow with the other hand.
	Overhead reach	Interlace the fingers, turn the palms upward and reach overhead, lengthening the sides of the trunk and the upper back.
	Behind-back clasp	Clasp the hands behind the back and lift gently, opening the chest and drawing the shoulder blades together.
Upper limbs	Wrist flexor and extensor stretch	With the elbow straight and the palm up (then down), use the other hand to draw the fingers back gently.
Back	Standing back extension and side-bend	Place the hands on the hips, lean back, then bend to each side to counter prolonged standing and forward bending.

IV. RESULTS

A. Participant profile

The study included 50 school teachers with a mean age of 46.80 ± 6.28 years (range 33–55 years). Twenty-one teachers (42%) were aged 41–50 years, 18 (36%) were 51 years or older and 11 (22%) were 31–40 years. Women made up 44 (88%) of the sample and men 6 (12%) (Table 2, Fig. 2).

Table 2: age and gender distribution of the participants (N = 50)

Variable	Category	n	Percentage (%)
Age group (years)	31–40	11	22.00
	41–50	21	42.00
	51 and above	18	36.00
Gender	Female	44	88.00
	Male	6	12.00
Total		**50**	**100.00**

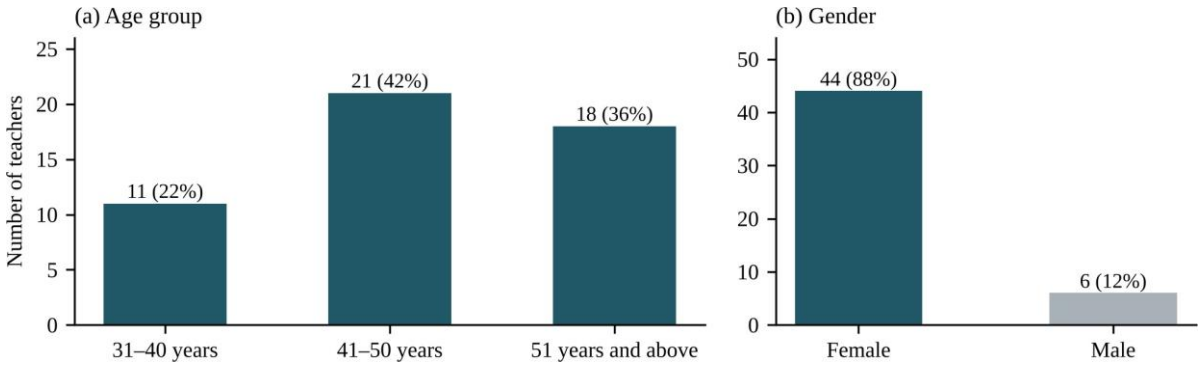

Fig. 2: age-group and gender distribution of the participants (N = 50).

B. Distribution of pain categories

At baseline the lower back was the most affected region: 37 teachers (74%) reported pain there, 31 (62%) of it moderate or severe and 12 (24%) severe. Pain was reported by 25 teachers (50%) at the ankles/feet, 24 (48%) each at the neck and shoulders, 21 (42%) at the wrists/hands, 19 (38%) at the knees and 16 (32%) at the upper back; elbow and hip/thigh pain was uncommon (10% and 12%). After the programme no teacher reported severe pain in any region, the 32 region-level instances of severe pain recorded at baseline having fallen to none (Table 3, Fig. 3). In every region the shift was from the moderate and severe categories towards mild pain, while the proportion with no pain changed very little, which suggests that the programme mainly reduced the intensity of existing pain rather than abolishing it.

Table 3: pain categories in the nine body regions before (pre) and after (post) the intervention, n (%) of 50 teachers

Body region	No pain (0)		Mild (1–3)		Moderate (4–6)		Severe (7–10)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Neck	26 (52%)	28 (56%)	4 (8%)	14 (28%)	15 (30%)	8 (16%)	5 (10%)	0 (0%)
Shoulders	26 (52%)	27 (54%)	5 (10%)	14 (28%)	12 (24%)	9 (18%)	7 (14%)	0 (0%)
Upper back	34 (68%)	33 (66%)	1 (2%)	13 (26%)	13 (26%)	4 (8%)	2 (4%)	0 (0%)
Elbows	45 (90%)	47 (94%)	1 (2%)	3 (6%)	4 (8%)	0 (0%)	0 (0%)	0 (0%)
Wrists/hands	29 (58%)	30 (60%)	3 (6%)	18 (36%)	18 (36%)	2 (4%)	0 (0%)	0 (0%)
Lower back	13 (26%)	15 (30%)	6 (12%)	22 (44%)	19 (38%)	13 (26%)	12 (24%)	0 (0%)
Hips/thighs	44 (88%)	44 (88%)	1 (2%)	6 (12%)	5 (10%)	0 (0%)	0 (0%)	0 (0%)
Knees	31 (62%)	32 (64%)	3 (6%)	12 (24%)	13 (26%)	6 (12%)	3 (6%)	0 (0%)
Ankles/feet	25 (50%)	26 (52%)	5 (10%)	20 (40%)	17 (34%)	4 (8%)	3 (6%)	0 (0%)

C. Change in pain intensity

Mean NPRS scores fell in all nine regions, and the reduction was statistically significant in each ($p < 0.05$; Table 4). The reductions were highly significant ($p < 0.001$) in six regions: the neck, shoulders, wrists/hands, lower back, knees and ankles/feet. The lower back showed the largest absolute reduction (4.00 to 2.14; 46.5%; $z = -5.35$, $p < 0.001$). The mean score averaged over the nine regions fell from 1.98 to 1.03, a reduction of 47.9% ($z = -6.16$, $p < 0.001$), and all 50 participants improved on this overall measure (Fig. 4). Relative reductions ranged from 36.5% (upper back) to 66.7% (elbows) (Fig. 5). The very large relative changes at the elbows and hips/thighs stem from low baseline scores in only 5 and 6 teachers respectively and should be read cautiously; the most dependable changes are those in the regions where 19–37 teachers had pain.

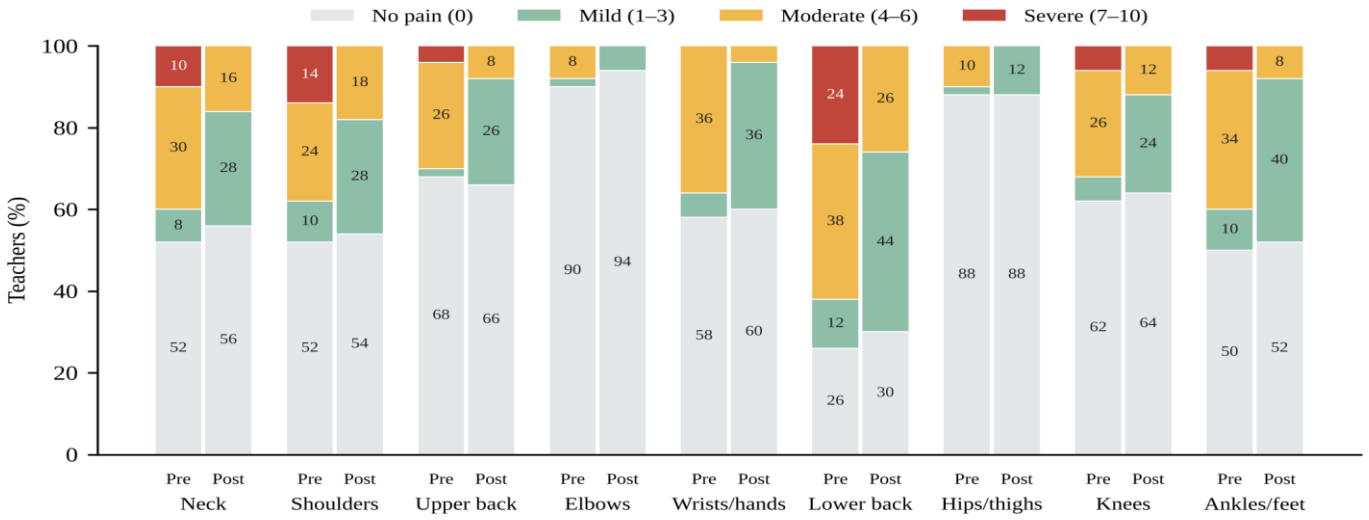

Fig. 3: distribution of pain categories before and after the intervention in the nine body regions (percentage of teachers).

Table 4: Wilcoxon signed-rank test of pre- and post-intervention NPRS scores (N = 50)

Body region	Pre-test mean ± SD	Post-test mean ± SD	z-value	p-value	Pain reduction (%)
Neck	2.40 ± 2.85	1.36 ± 1.79	−4.20	< 0.001	43.3
Shoulders	2.48 ± 2.96	1.36 ± 1.84	−4.33	< 0.001	45.2
Upper back	1.70 ± 2.61	1.08 ± 1.66	−2.87	0.004	36.5
Elbows	0.42 ± 1.34	0.14 ± 0.57	−2.03	0.042	66.7
Wrists/hands	1.88 ± 2.36	0.86 ± 1.25	−4.08	< 0.001	54.3
Lower back	4.00 ± 2.89	2.14 ± 1.80	−5.35	< 0.001	46.5
Hips/thighs	0.56 ± 1.58	0.22 ± 0.65	−2.26	0.024	60.7
Knees	1.90 ± 2.67	1.04 ± 1.58	−3.85	< 0.001	45.3
Ankles/feet	2.50 ± 2.85	1.10 ± 1.39	−4.42	< 0.001	56.0
Overall (mean of 9 regions)	**1.98 ± 0.97**	**1.03 ± 0.61**	**−6.16**	**< 0.001**	**47.9**

NPRS, Numeric Pain Rating Scale (0–10); SD, standard deviation; z, standardised Wilcoxon statistic (negative values indicate lower post-intervention scores); pain reduction = (pre mean − post mean) / pre mean × 100. All differences were significant at $p < 0.05$.

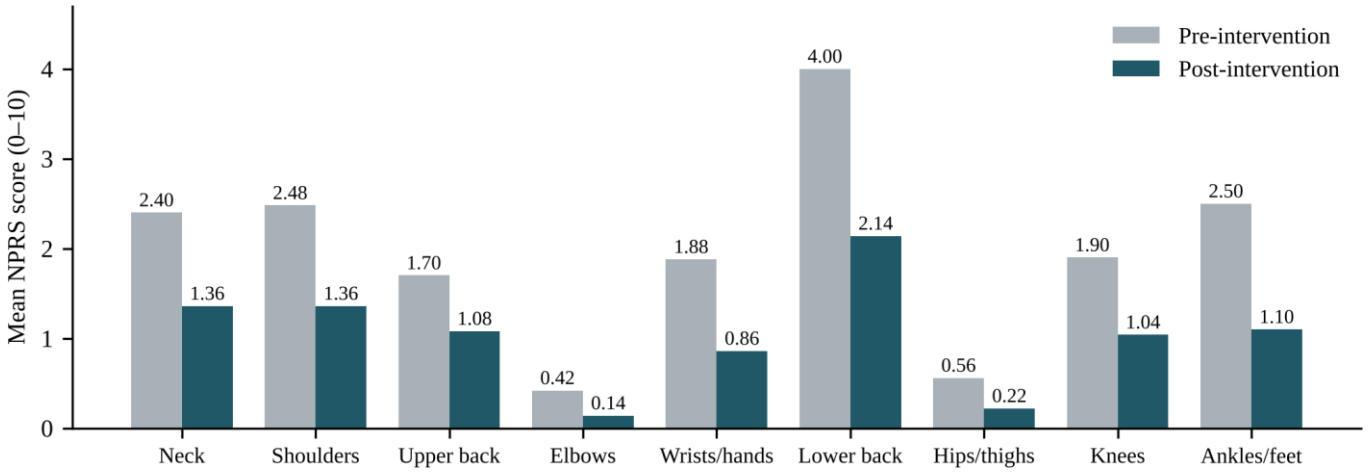

Fig. 4: mean NPRS pain scores before and after the intervention.

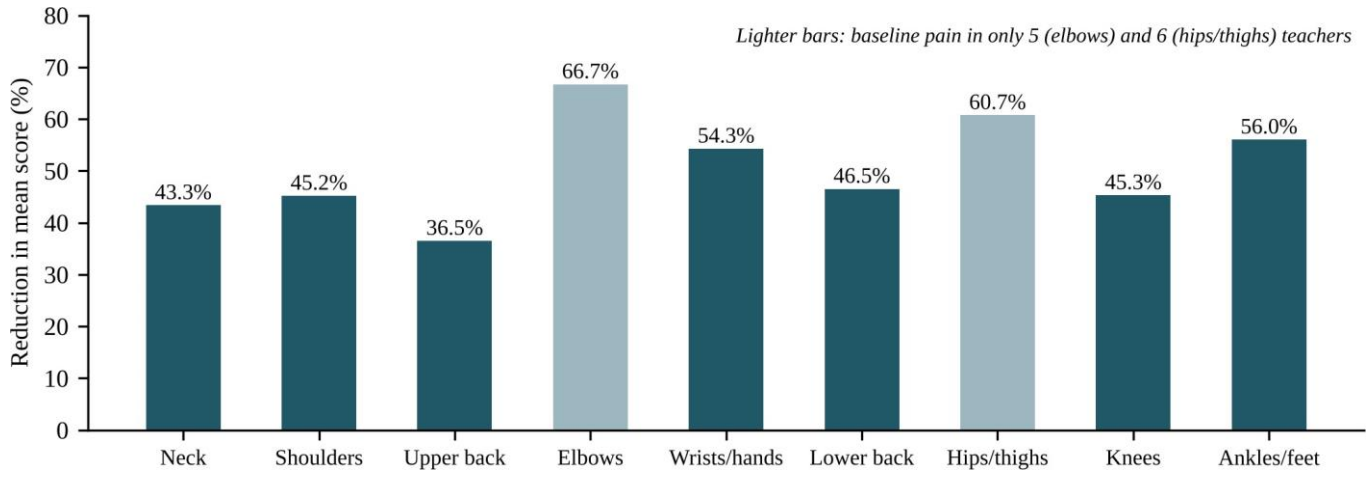

Fig. 5: percentage reduction in mean pain score by body region.

D. Testing of the hypothesis

Because pain fell significantly in all nine body regions ($p < 0.05$) and in the overall score ($p < 0.001$), the null hypothesis was rejected and the alternative hypothesis accepted: micro-breaks with stretching exercises significantly reduced musculoskeletal pain among the school teachers studied.

V. DISCUSSION

This experimental study found that micro-breaks combined with stretching were followed by significant reductions in pain in all nine body regions and by 47.9% overall, and that no teacher reported severe pain afterwards.

A. Participants and baseline pain

Most participants were women (88%) and over 40 years of age (78%). Teaching is a female-dominated profession, and female sex has been reported as a predictor of musculoskeletal pain in academic staff [3], so the sample reflects a population at risk. Years of static loading together with age-related changes in muscle, tendon and disc may add to symptoms in mid-career and senior teachers. The lower back (74% affected; mean NPRS 4.00) and the ankles/feet (50%) carried the heaviest burden, followed by the neck and shoulders (48% each). This pattern accords with reports that prolonged standing and awkward postures drive neck, shoulder and low back pain in school teachers [2] and that the shoulders, neck and lower back are the commonest sites in academic faculty [3]. The high lumbar and lower-limb load is plausible, because teachers stand for long periods on hard floors and lean over desks and notebooks.

B. Effect of the programme

Mean pain fell significantly in the neck, shoulders, upper back, wrists/hands, lower back, knees and ankles/feet and, from lower starting points, at the elbows and hips/thighs. A reduction of about 30% or more on an 11-point numerical scale is generally regarded as clinically important [12]; all nine regions exceeded this threshold (36.5–66.7%), so the changes were probably meaningful to the teachers as well as statistically significant.

C. Possible mechanisms

Several mechanisms may explain the benefit. Micro-breaks interrupt static muscle contraction, allowing blood flow to return and metabolites such as lactate to be cleared, so that fatigue is prevented rather than corrected afterwards; frequent short pauses are therefore physiologically preferable to one long rest. Stretching reduces the stiffness of the muscle–tendon unit through viscoelastic stress relaxation, lengthens shortened muscles such as the upper trapezius, levator scapulae and pectorals, may transiently lower muscle spindle sensitivity and motoneuron excitability, and increases local circulation; the sensory input from stretch may also modulate nociception through spinal gating and endogenous pain inhibition.

Teaching postures also load the body repeatedly. Forward head posture while marking raises the flexion moment on the cervical spine and the demand on the upper trapezius; writing on a board with the arms elevated loads the supraspinatus and deltoid and narrows the subacromial space; standing with a forward lean loads the lumbar spine and, through creep of passive tissues, shifts load from muscle to ligaments and discs; hard floors promote venous pooling and load the knees, ankles and plantar structures; and repetitive pen, chalk and keyboard use loads the wrist flexors and extensors. Changing posture every few minutes and moving the joints through their range resets creep, redistributes load and restores neutral alignment, which may explain why symptoms in the neck, shoulders, wrists, lower back and lower limbs all responded to a single simple routine.

D. Comparison with earlier studies

The findings agree with earlier work. Rabal-Pelay et al. [5] reported significant falls in neck, low back and total discomfort after an eight-week active-break programme in office workers; here, neck and lower back pain fell by 43.3% and 46.5%. The pooled finding of Yaghoubitajani et al. [6] that micro-exercises of 2–15 minutes reduce neck and shoulder pain is consistent with the 43.3% and 45.2% reductions seen with 2–3-minute breaks. Controlled data show that stretching reduces complaints in construction workers [7] and, with ergonomic changes, in office workers [8], while the link between activity breaks, ergonomics and back pain in teaching staff [4] and the call for ergonomic interventions in academic staff [3] support the preventive approach tested here. Unlike Rabal-Pelay et al., who found no significant change in perceived stress, stress was not measured in this study,

so the effect of micro-breaks on teachers' psychological stress remains to be studied.

E. Interpretation with caution

Several points temper these conclusions. With one group and no control, part of the improvement may reflect regression to the mean, natural fluctuation of symptoms, expectancy effects or the attention received from the investigator. The p-values for the elbows (0.042) and hips/thighs (0.024) came from only 5 and 6 teachers whose scores changed and would not remain significant after Bonferroni correction for nine comparisons ($\alpha = 0.0056$), whereas the other seven regions would. One teacher in the neck region and one in the upper back region reported higher pain afterwards, a reminder that individual responses vary. The results are best read as strong evidence of short-term benefit in this sample rather than proof of causation.

VI. Clinical Implications

The programme needs no equipment and only a few minutes, so it can be fitted into the timetable without disrupting teaching, making it a practical first-line preventive measure. Physiotherapists can prepare region-specific stretching charts and teach them during in-service sessions. Schools may consider scheduled movement pauses, adjustable seating and writing surfaces, anti-fatigue standing arrangements and ergonomic training. Because the lower back and lower limbs were the most affected regions, teachers who stand for long periods should be encouraged to alternate postures, move regularly and stretch the back and legs. Early screening with the NMQ and NPRS can prompt timely intervention and help limit presenteeism, absenteeism and long-term disability.

VII. Limitations

The single-group pre–post design without a control group means that the effect of the intervention cannot be separated from regression to the mean, natural recovery or expectancy. Convenience sampling of 50 teachers limits generalisability, few teachers had elbow or hip/thigh pain, and 88% of the participants were women, so findings in male teachers are uncertain. Pain was self-reported on an ordinal scale and is open to recall and response bias; no objective measures such as range of motion, algometry or electromyography were used. Adherence relied on supervision and self-report, there was no follow-up after the intervention, and stress, workload, teaching hours and workstation ergonomics were neither measured nor controlled.

VIII. Future Scope

Randomised controlled trials comparing micro-breaks with stretching against a control group, or against each component alone, would establish causality and the contribution of each element. Larger multicentre samples across school types and regions, with more male teachers and a calculated sample size, would improve generalisability, while longer follow-up and different break frequencies and durations would show how well the benefit is sustained and what dose is best. Range of motion, pressure pain threshold, muscle activity, perceived stress, work ability and productivity could be added as outcomes, and combining the programme with classroom ergonomic changes and evaluating its cost-effectiveness and school-level implementation would support policy development.

IX. Conclusion

Musculoskeletal pain was common in this sample of 50 school teachers, most often in the lower back, ankles/feet, neck and shoulders. After a programme of micro-breaks with stretching, pain fell significantly in all nine body regions ($p < 0.05$), the mean pain score averaged over the regions dropped by 47.9%, and no teacher reported severe pain. A simple, low-cost programme of micro-breaks combined with stretching appears effective in reducing musculoskeletal pain among school teachers and can be recommended as a preventive physiotherapy strategy in schools, pending confirmation in controlled trials.

X. Acknowledgment

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