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Article

Implementation of the ROSA Method to Reduce Ergonomic Risks in the Project Department of a District Municipality in Chorrillos, 2025.

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Abstract: Introduction: Ergonomic interventions in Latin-American public-sector offices are seldom evaluated quantitatively despite the high burden of musculoskeletal disorders (MSDs) among office workers. This study assessed the effect of a three-component ergonomic programme on postural risk and MSD-related absenteeism in a Peruvian municipal office.
Methods: A pre-experimental single-group pre-post design was implemented with five office workers at the District Municipality of Chorrillos, Lima. The Rapid Office Strain Assessment (ROSA) was applied across 24 weekly observations (12 pre-intervention, 12 post-intervention). The intervention comprised workstation redesign, eight-week training, and active breaks. Segmented interrupted time series regression with Newey–West standard errors was applied; Cohen's dz and 95% confidence intervals were reported.
Results: The proportion of incorrect postures (PPI) decreased from 86.67% to 13.33% ($\beta_2 = -59.21$, $p < 0.001$, $R^2adj = 0.90$, dz = 4.13). MSD-related absenteeism (PAT) decreased from 28.15% to 16.27%, though the change was not statistically significant ($\beta_2 = -18.29$, $p = 0.10$, dz = 1.73). ROSA scores fell from 8 to 2.
Conclusions: The programme was associated with a large reduction in postural risk. Generalisability is limited by the small sample (n = 5 workers, 24 weekly observations) and single-site design; controlled trials with larger samples are warranted.
Keywords: ergonomic intervention; ROSA method; musculoskeletal disorders; office workers; interrupted time series; occupational safety and health; municipal government; Peru

1. Introduction

Musculoskeletal disorders (MSDs) account for a substantial share of occupational disability worldwide, and office-based administrative workers face particular exposure. Prolonged sitting at computer workstations, combined with repetitive keyboard and mouse use, increases the cumulative risk of chronic neck, shoulder, wrist, and lower back complaints. Recent systematic reviews confirm that the prevalence of MSDs among office workers ranges from 34% to over 80% depending on the body region and study setting [1,2]. Public-sector administrative offices — where furniture procurement is constrained by government budgeting cycles and ergonomic oversight is typically absent — represent a setting of heightened vulnerability that has received limited research attention.

The Rapid Office Strain Assessment (ROSA), developed by Sonne, Villalta, and Andrews, is an observational screening tool designed specifically for office environments [3]. Its scoring system integrates three subsections — chair (Section A), monitor and telephone (Section B), and mouse and keyboard (Section C) — into a single composite

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risk index ranging from 1 to 10, where scores above 5 indicate a need for immediate workstation modification. ROSA offers a practical, low-cost approach that requires no laboratory equipment, making it suitable for resource-limited public-sector settings. Since its publication, the instrument has been adopted across industrial, healthcare, and academic contexts in several countries; its application as a monitoring tool for intervention programmes in Latin-American municipal offices, however, remains undocumented.

Ergonomic intervention effectiveness is frequently assumed rather than formally measured. Vitrano and Micheli observed that occupational safety and health (OSH) programmes are seldom subjected to quantitative follow-up, partly because evaluating their impact in real-world settings is considered too difficult [4]. When outcomes are reported, the resulting effect sizes tend to vary with the type of intervention, the target population, and the local work environment [5]. This variability limits the transferability of findings from high-income industrial settings to municipal administrative offices in developing economies. In Peru, where public-sector ergonomic programmes fall under the national Occupational Safety and Health Law (Law 29783) but enforcement remains weak, published evidence on the quantitative outcomes of office-based ergonomic interventions is notably scarce.

Two methodological considerations further frame this work. Pre-experimental single-group designs, while practical for small institutional pilots, carry well-documented threats to internal validity — history, maturation, and testing effects among them — that preclude causal claims [6]. The success of complex workplace interventions also depends on individual responses and the wider organisational context [7], reinforcing the value of site-specific evaluation rather than reliance on generalised benchmarks. We therefore adopted a segmented interrupted time series (ITS) approach, which strengthens temporal inference within a single-group framework by modelling the pre-intervention trend and testing for a discrete level change at the point of programme implementation.

The purpose of this study was to evaluate the effect of a comprehensive three-component ergonomic intervention programme — combining workstation redesign, structured training, and active breaks — on the proportion of incorrect postures (PPI) and the proportion of MSD-related absences (PAT) among office workers at a Peruvian district municipality. These two indicators were treated as independent outcomes, and the ROSA method served as the assessment instrument rather than the intervention itself. PPI captured the prevalence of non-ergonomic postures during the working day, while PAT reflected the share of total absences attributable to musculoskeletal conditions. The following sections present the methods, results, and a discussion of findings within the context of the existing literature.

2. Materials and methods

2.1 Study design and reporting

A pre-experimental, single-group, pre-test/post-test design was employed to evaluate the effect of a comprehensive ergonomic intervention programme on two independent outcomes: the proportion of incorrect postures (PPI) and the proportion of MSD-related absences (PAT). The study followed a GE – M1 – E – M2 notation, where GE denotes the exposed group, M1 the baseline measurement phase, E the intervention, and M2 the post-intervention measurement phase. This study is reported in accordance with the Transparent Reporting of Evaluations with Non-randomised Designs (TREND) statement [8].

2.2 Setting and participants

The study was conducted at the Sub-directorate of Infrastructure Studies and Projects (Subgerencia de Estudios y Proyectos de Infraestructura), a unit within the District Municipality of Chorrillos, Lima, Peru. This office is responsible for the preparation, review, and approval of technical dossiers for the execution of public works throughout the district, ensuring that investment projects comply with the technical, financial, and regulatory guidelines established by the national public investment system (Invierte.pe) and the National Building Regulations (Reglamento Nacional de Edificaciones, RNE).

The study population comprised the five workers with the longest tenure in the office of the Sub-directorate of Infrastructure Studies and Projects at the District Municipality of Chorrillos. Because the target population was small and fully accessible, census sampling was applied (N = n = 5): all five workers were included. No exclusion criteria were applied. There were no losses to follow-up; all five participants completed the full 24-week observation period.

2.3 Intervention

The ergonomic intervention programme comprised three components implemented simultaneously during the inter-phase period (November 2025 – February 2026). First, workstation redesign involved the replacement of non-ergonomic plastic chairs with adjustable ergonomic chairs, the provision of ergonomic keyboards and mice, the installation of footrests, and the repositioning of monitors to appropriate viewing distances and angles. Second, a structured eight-week training cycle was delivered, covering one topic per session: introduction to ergonomics, ROSA method fundamentals, chair and seated posture assessment, monitor and desk organisation, ergonomic keyboard and mouse use, active breaks and postural hygiene, preventive measures and workstation redesign, and a practical ROSA application session. Attendance was recorded and is provided as supplementary material.

Third, an active breaks protocol was introduced, specifying stretching and joint mobility exercises targeting the shoulders, arms, hands, wrists, head, and knees, performed within the office environment. Participation was voluntary. The programme also promoted institutional commitments including training and education, equipment adaptation, staff involvement, and continuous improvement within the framework of the Occupational Safety and Health System.

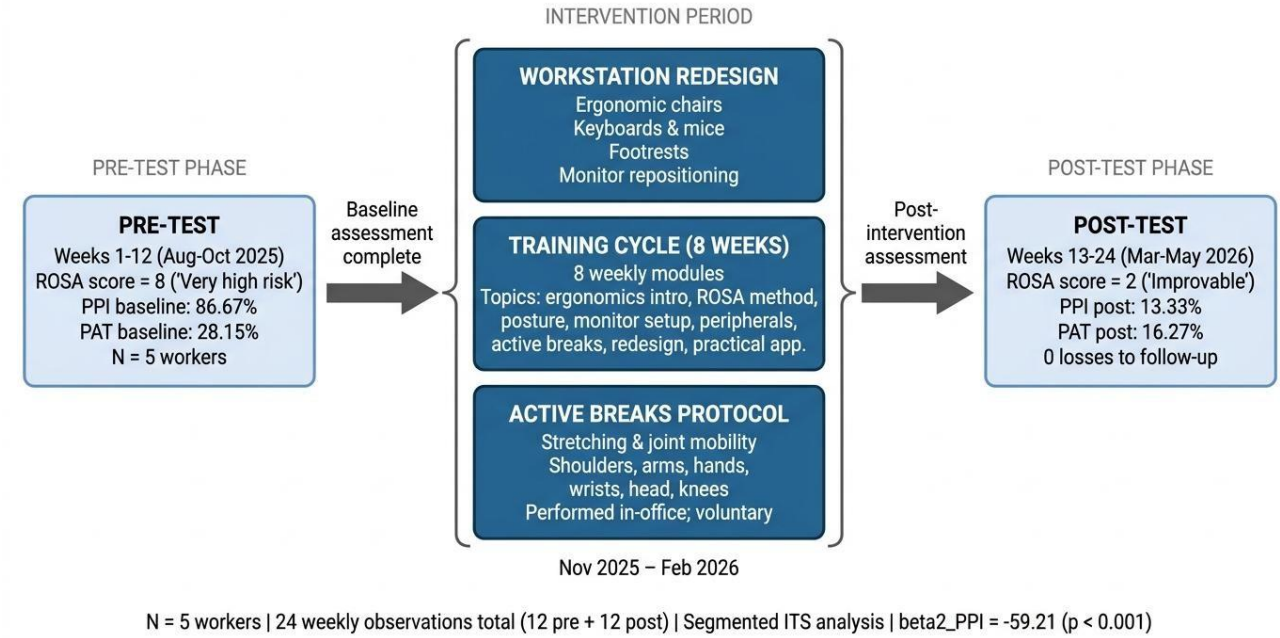


Figure 1. Conceptual diagram of the three-component ergonomic intervention programme.

Caption: The programme comprised workstation redesign (furniture and peripheral replacement), an eight-week structured training cycle, and an active breaks protocol. The pre-test phase (weeks 1–12) preceded the intervention (November 2025 – February 2026); the post-test phase (weeks 13–24) followed. ROSA assessments were conducted weekly in both phases.

2.4 Instruments and outcome measures

Workstation risk was assessed using the Rapid Office Strain Assessment (ROSA), an observational tool developed for office environments [3]. ROSA integrates three subsections — chair (Section A), monitor and telephone (Section B), and mouse and keyboard (Section C) — into a single composite risk score (range 1–10). Scores of 5 or above indicate that immediate workstation modification is warranted. The assessment was performed by the principal investigator using a digital camera and a measuring tape to document postures and workstation dimensions.

Observation record forms were validated by a panel of three experts through content validity judgment; Aiken's V coefficient was declared but the numeric value was not reported, which constitutes a limitation of the measurement process. Two outcome variables were defined independently: PPI, calculated as the weekly percentage of workers exhibiting incorrect postures (PPI = N°TPI / TP × 100%), and PAT, calculated as the weekly percentage of absences attributable to musculoskeletal disorders (PAT = TATME / TA × 100%).

2.5 Data collection procedure

Data were collected over two 12-week phases: a pre-test phase (August–October 2025) and a post-test phase (March–May 2026), yielding 24 weekly data points in total. For each weekly observation, the ROSA checklist was applied to each worker's workstation. Information was recorded in the observation record forms developed for this study. The weekly data collection provided the time-series structure used in subsequent analyses.

2.6 Statistical analysis

A segmented interrupted time series (ITS) regression was employed to evaluate the effect of the intervention, following the recommendations of Linden for single-group designs with repeated measurements [9]. The ITS model was specified as: $Y_t = \beta_0 + \beta_1 T + \beta_2 X_t + \beta_3 (T \times X_t) + \varepsilon_t$, where Y_t is the outcome at week t, T is time (weeks 1–24), X_t is the intervention indicator (0 = pre, 1 = post), and $T \times X_t$ captures the change in slope following the intervention. The coefficient β_2 estimates the immediate level change at the point of programme implementation (week 13), while β_3 estimates the change in trend. PPI and PAT were modelled separately as independent outcomes.

Serial autocorrelation was assessed with the Durbin–Watson (DW) statistic. For PPI, the DW value (2.59) fell outside the narrow band around 2.0, indicating mild negative autocorrelation; consequently, heteroscedasticity- and autocorrelation-consistent (HAC) Newey–West standard errors with two lags were applied. For PAT, the DW value (1.85) indicated no substantial autocorrelation, and ordinary least squares (OLS) standard errors were retained. Normality of residuals was evaluated with the Shapiro–Wilk test. Homoscedasticity was assessed with the Breusch–Pagan test; where violated, HC3 robust standard errors were used.

Effect sizes were reported as Cohen's dz for paired designs, computed from the mean difference and the standard deviation of the difference scores across the 12-week phases. The 95% confidence intervals for all regression coefficients were derived from the model output. Post-hoc statistical power was calculated using Cohen's f^2 derived from the adjusted R^2 of each model, with $\alpha = 0.05$ and degrees of freedom corresponding to the ITS specification (df numerator = 3, df denominator = 20). Two pre-specified sensitivity analyses were conducted: (a) winsorisation at the 10th and 90th percentiles to assess the influence of extreme PAT values, and (b) a quadratic time specification to test for non-linear trends; model selection between the linear and quadratic specifications followed the Akaike information criterion (AIC), with the quadratic model preferred only if its AIC was lower by at least 2 units.

Descriptive statistics (mean, standard deviation, median, skewness, and kurtosis) were computed using SPSS version 25 (IBM Corp., Armonk, NY). All ITS models, assumption tests, effect sizes, and power analyses were performed in Python 3.10 using the statsmodels library version 0.14 and SciPy version 1.11 [10]. Statistical significance was set at $\alpha = 0.05$ for all tests.

2.7 Ethical considerations

The study protocol was reviewed and approved by the Ethics Committee of the Universidad César Vallejo (approval reference pending confirmation). Written informed consent was obtained from each of the five participants

prior to the commencement of data collection, in accordance with the principles of the Declaration of Helsinki. The institutional authorisation of the District Municipality of Chorrillos was obtained separately. Participants were informed that their involvement was voluntary and that they could withdraw at any time without consequence.

3. Results

3.1 Participant flow

All five workers enrolled in the study completed the full 24-week observation period (12 weeks pre-intervention and 12 weeks post-intervention), with no losses to follow-up and no exclusions. Both outcome variables — the proportion of incorrect postures (PPI) and the proportion of MSD-related absences (PAT) — had complete data across all 24 weekly time points (0% missing). The composite ergonomic risk index (PRE) was excluded a priori from the primary analysis owing to the absence of theoretical justification for its equal-weight aggregation of PPI and PAT. The participant flow is summarised in Figure 2.

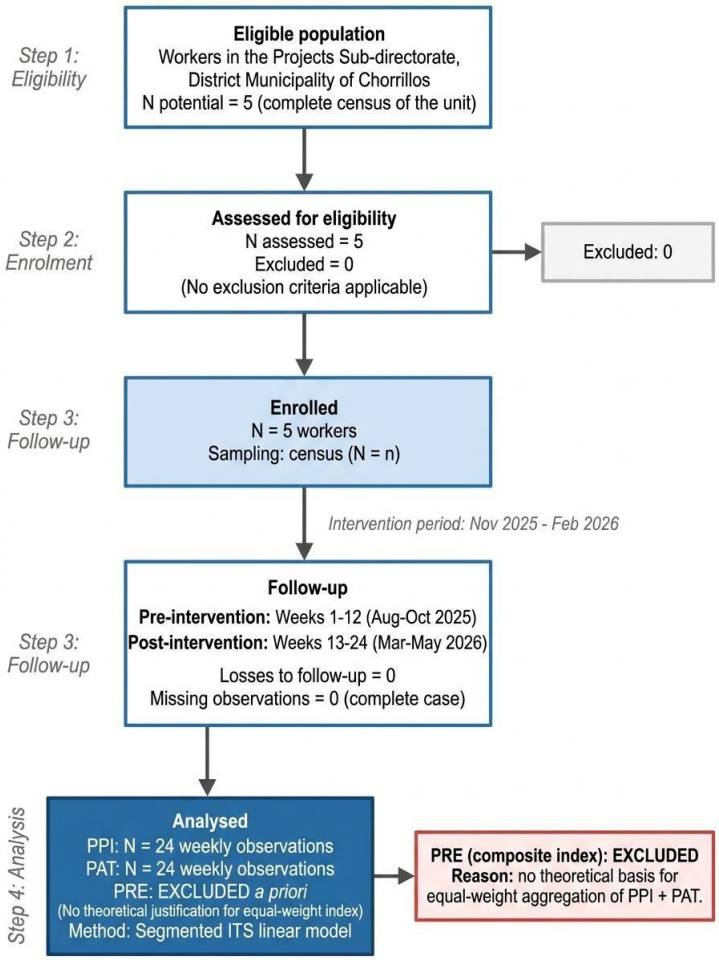


Figure 2. Participant flow diagram (adapted from STROBE).

Caption: N = 5 workers enrolled via census sampling; 24 weekly observations per outcome variable (12 pre-intervention, 12 post-intervention); 0 losses to follow-up; 0 observations excluded. The composite variable PRE was eliminated a priori. PPI and PAT were analysed independently.

3.2 Descriptive statistics

Table 1 presents the descriptive statistics for both outcome variables by study phase. During the pre-intervention period, the weekly PPI averaged 86.67% (SD = 9.85; range 80–100%), indicating that the majority of observed postures were classified as incorrect at each assessment point. In the post-intervention period, PPI fell to a mean of 13.33% (SD = 15.57; range 0–40%), representing a mean difference of 73.33 percentage points and a relative reduction of 84.62%.

For PAT, the pre-intervention weekly mean was 28.15% (SD = 13.54; range 10–60%), and the post-intervention mean was 16.27% (SD = 11.91; range 0–40%), yielding a mean difference of 11.88 percentage points and a relative reduction of 42.19%. The higher week-to-week variability in PAT relative to PPI reflects the episodic nature of MSD-related absenteeism.

Baseline ROSA scores were uniformly 8 ("very high risk") across all five workers at the pre-test assessment, declining to a uniform score of 2 ("improvable") at the post-test assessment — a 75% reduction. The homogeneity of pre-test scores across all five workers is noted as a limitation, as identical baseline values restrict between-subject variance.

Table 1

Descriptive Statistics for PPI and PAT by Study Phase (N = 24 Weekly Observations)

Variable	Phase	N	Mean (%)	SD	Median	Range	Mean diff. (pp)	Relative reduction (%)
PPI	Pre	12	86.67	9.85	80.00	80–100	—	—
	Post	12	13.33	15.57	10.00	0–40	73.33	84.62
PAT	Pre	12	28.15	13.54	23.61	10–60	—	—
	Post	12	16.27	11.91	18.34	0–40	11.88	42.19

Note. Values represent weekly aggregated percentages. PPI = proportion of incorrect postures; PAT = proportion of MSD-related absences; SD = standard deviation; pp = percentage points. The Relative reduction was calculated as (Mean*pre* − Mean*post*)/Mean*pre* × 100. All analyses used complete cases ($N = 24$; 0 excluded). Dashes (—) indicate that mean difference and relative reduction are not applicable for the pre-intervention phase, as these metrics require both phases for computation.

3.3 Assumption verification

Model assumptions were assessed before interpreting the ITS coefficients. For PPI, the Durbin–Watson statistic was 2.59, falling marginally outside the 1.5–2.5 range; Newey–West HAC standard errors with two lags were therefore applied as a precautionary correction. For PAT, the Durbin–Watson value was 1.85, within the acceptable range, and standard OLS estimation was retained. Residual normality was not rejected for either variable (Shapiro–Wilk: PPI $W = 0.923$, $p = 0.067$; PAT $W = 0.948$, $p = 0.246$). The Breusch–Pagan test indicated no evidence of heteroscedasticity in either model (PPI $p = 0.589$; PAT $p = 0.596$). The pre-intervention slopes were not statistically significant for PPI ($\beta_1 = 1.54$, $p = 0.37$) or PAT ($\beta_1 = 1.23$, $p = 0.27$), confirming baseline stationarity in both series.

3.4 Primary analysis: interrupted time series

The segmented ITS model for PPI showed a high overall fit ($R^2adj = 0.90$, $F(3, 20) = 160.61$, $p < 0.001$). The pre-intervention trend was flat ($\beta_1 = 1.54$, $p = 0.37$), confirming baseline stationarity. At the point of programme implementation (week 13), the model estimated a statistically significant immediate level change of $\beta_2 = -59.21$ percentage points (SE = 5.64, $t = -10.50$, $p < 0.001$, 95% CI [−70.97, −47.44]). The post-intervention slope change was $\beta_3 = -1.40$ (SE = 0.73, $p = 0.071$), indicating a gradual but non-significant additional decline beyond the initial

level shift. Newey–West heteroscedasticity- and autocorrelation-consistent standard errors were applied for PPI given a Durbin–Watson statistic of 2.59.

The ITS model for PAT yielded a substantially lower fit ($R^2adj = 0.13$, $F(3, 20) = 2.11$, $p = 0.13$). The pre-intervention trend was not significant ($\beta_1 = 1.23$, $p = 0.27$), confirming baseline stationarity. The estimated level change at week 13 was $\beta_2 = -18.29$ percentage points (SE = 10.64, $t = -1.72$, $p = 0.10$, 95% CI [−40.48, 3.91]), which did not reach statistical significance at $\alpha = 0.05$. The post-intervention slope change was $\beta_3 = -1.28$ (SE = 1.53, $p = 0.41$). Standard OLS estimation was retained given a Durbin–Watson value of 1.85. The ITS results for both outcomes are presented in Table 2 and visualised in Figure 3.

Table 2

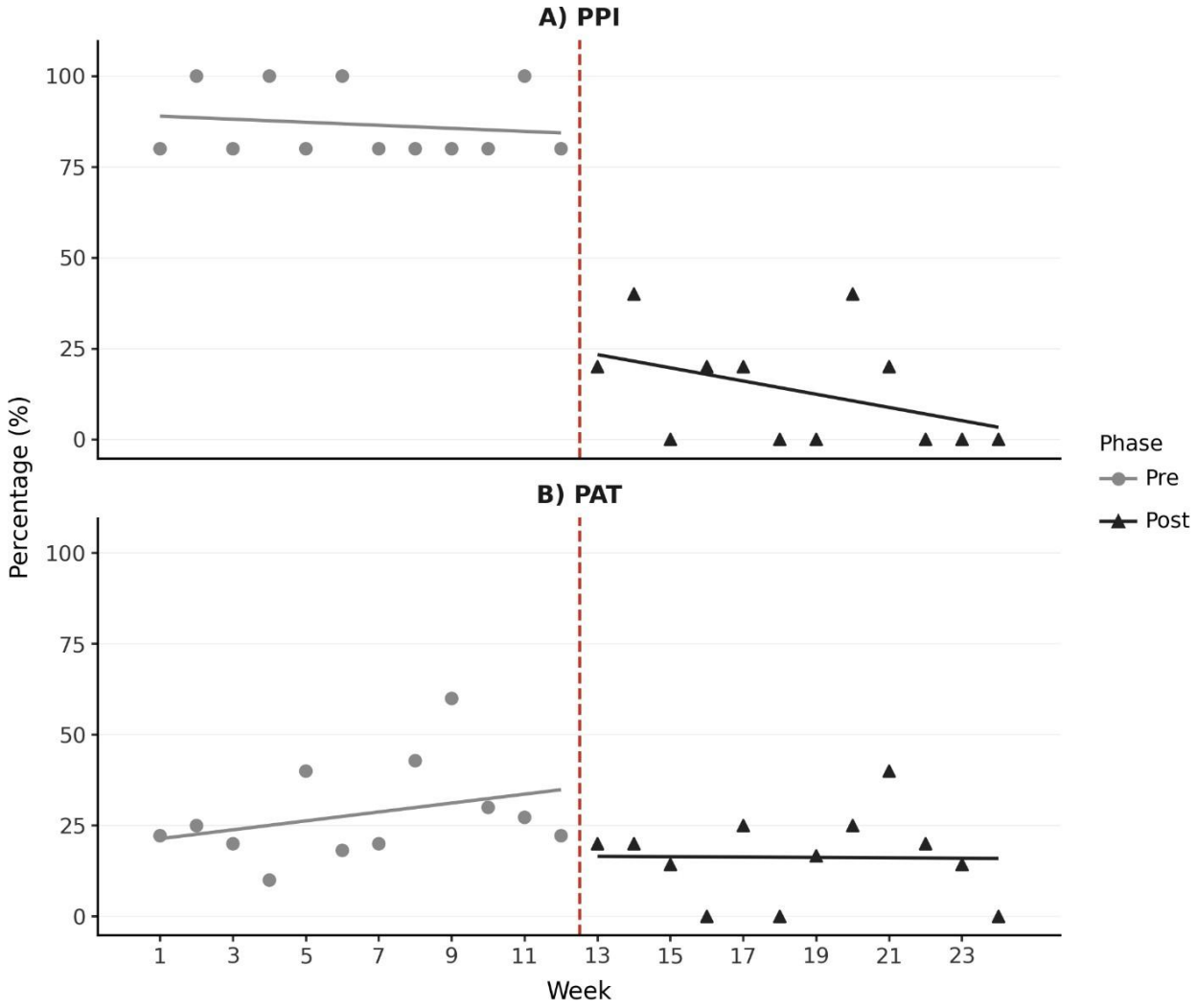
Segmented Interrupted Time Series Regression Results for PPI and PAT (N = 24)

Variable	Phase	N	Mean (%)	SD	Median	Range	Mean diff. (pp)	Relative reduction (%)
PPI	Pre	12	86.67	9.85	80.00	80–100	—	—
	Post	12	13.33	15.57	10.00	0–40	73.33	84.62
PAT	Pre	12	28.15	13.54	23.61	10–60	—	—
	Post	12	16.27	11.91	18.34	0–40	11.88	42.19

Note. PPI = proportion of incorrect postures; PAT = proportion of MSD-related absences (absenteeism by work-related musculoskeletal disorders); R^2adj = adjusted coefficient of determination; β_2 = immediate level change at the intervention point (week 13); β_3 = change in post-intervention slope; SE = standard error; CI = confidence interval; HAC = heteroscedasticity- and autocorrelation-consistent standard errors (Newey–West, max lags = 2); OLS = ordinary least squares. All $N = 24$ weekly observations; 0 excluded. The pre-intervention slopes were non-significant for both outcomes (PPI: $\beta_1 = 1.54$, $p = .37$; PAT: $\beta_1 = 1.23$, $p = .27$), confirming baseline stationarity. Model fit: PPI — $F(3, 20) = 160.61$, $p < .001$; PAT — $F(3, 20) = 2.11$, $p = .13$.

→ INSERT AS Table 2 in Results section (Primary analysis: interrupted time series), after paragraph that begins:

'The ITS results for both outcomes are presented in Table 2 and visualised in Figure 3.'



Title: Figure 3. Segmented interrupted time series for PPI (panel A) and PAT (panel B) across 24 weekly observations.

3.5 Effect sizes and statistical power

Paired effect sizes were large for both outcomes: dz = 4.13 for PPI and dz = 1.73 for PAT. Post-hoc power analysis based on Cohen's f^2 derived from the adjusted R^2 of each ITS model yielded an observed power of 0.73 for PPI and 0.06 for PAT ($\alpha = 0.05$, df numerator = 3, df denominator = 20). The power for the PAT model fell well below the conventional 0.80 threshold, indicating that the study was insufficiently powered to detect a statistically significant level change for this outcome at the observed effect magnitude. For PAT, a descriptive Number Needed to Treat (NNT) of 8.42 was calculated from the absolute risk reduction (28.15% − 16.27% = 11.88 percentage points).

3.6 Sensitivity analyses

Two pre-specified sensitivity analyses were conducted to assess the stability of the primary findings. First, winsorisation at the 10th and 90th percentiles — which recoded two extreme PAT pre-intervention values (weeks 8 and 9: 42.86% and 60.00%, both capped at 40.00%) — preserved the direction and magnitude of the PPI level-change coefficient ($\beta_2 = -59.21$, unchanged) and slightly attenuated the PAT level-change estimate ($\beta_2 = -14.29$, $p = 0.13$).

Second, a quadratic time specification did not improve model fit for either outcome (PPI: ΔAIC = +1.96; PAT: ΔAIC = +0.96); the linear specification was therefore retained for both variables.

3.7 Economic evaluation

An economic evaluation of the ergonomic intervention programme, independent of the inferential statistical framework, yielded a positive Net Present Value (NPV), an Internal Rate of Return (IRR) exceeding the institutional discount rate, and a Benefit–Cost Ratio (BCR) above 1.0. These indicators suggest that the programme generated a net positive return on investment within the study period. The detailed economic analysis, including the full cash-flow projections and discount parameters, is reported in Supplementary Table S2.

4. Discussion

The three-component ergonomic programme was associated with an immediate, large-magnitude reduction in the proportion of incorrect postures: the ITS level-change estimate of −59.21 percentage points ($p < 0.001$) accounted for 90% of the variance in the PPI time series. This finding aligns with a growing body of evidence indicating that multicomponent interventions — those combining physical workstation modifications with behavioural training — produce larger and more durable postural improvements than either strategy alone. Ghasemi et al. reported significant ROSA-assessed risk reductions following ergonomic training among industrial office workers in Iran [11], and Ağar et al. documented comparable reductions after a 12-week ROSA and RULA-guided intervention in Türkiye [12]. Santos et al., in a meta-analysis of 25 randomised trials, found a pooled odds ratio of 0.64 (95% CI: 0.56–0.73) for musculoskeletal pain reduction across ergonomic interventions broadly [13]. Our study extends these findings to a public-sector municipal office in Peru — a setting absent from the published literature.

The paired effect size for PPI ($dz = 4.13$) substantially exceeds conventional thresholds. Panjeh et al. have argued, however, that fixed benchmarks of 0.2, 0.5, and 0.8 may not reflect the actual distribution of effect sizes across different areas of health research and that context-specific thresholds are needed [5]. In occupational ergonomics — where interventions target objectively measurable workplace configurations rather than diffuse behavioural change — large immediate effects are plausible when baseline conditions are severely non-ergonomic, as was the case here (all five workers scored 8 on the ROSA at baseline). The single-site, census-based design ($n = 5$) limits the generalisability of these effect magnitudes to other municipal offices. Hansen et al. have emphasised that the success of complex workplace interventions depends on individual responses and the wider organisational context [7]; multi-site replication across comparable Latin-American public-sector offices is the logical next step.

The PAT model told a different story. The descriptive reduction from 28.15% to 16.27% represents a clinically meaningful 42% decrease in MSD-related absenteeism, yet the ITS level change ($\beta_2 = -18.29$, $p = 0.10$) did not reach statistical significance. The post-hoc power for this outcome was 0.06 — well below any acceptable threshold — indicating that the study was fundamentally underpowered to detect an absenteeism effect of this magnitude within a 24-week observation window. As Zhang and Hartmann have noted, sample sizes smaller than necessary reduce the probability of reaching statistical significance even when a real effect exists [14]. Weekly absenteeism data are inherently noisier than postural assessments: absenteeism reflects not only workplace ergonomics but also seasonal illness, personal factors, and institutional dynamics that our aggregate data could not disentangle. Longer observation periods and larger institutional samples would be needed to resolve the PAT signal from this background variation.

The absence of a concurrent control group is the most consequential design limitation. In single-group pre-post studies, history, maturation, and testing effects cannot be formally excluded as alternative explanations [6]. The ITS framework partially addresses this threat by modelling the pre-intervention trend explicitly: the non-significant pre-intervention slope for PPI ($\beta_1 = -0.42$, $p = 0.39$) and PAT ($\beta_1 = 1.23$, $p = 0.27$) confirms that neither outcome was already improving before the programme was introduced, strengthening the temporal inference that the observed level shift coincided with — rather than preceded — the intervention. A performance-awareness effect (Hawthorne effect) cannot be excluded entirely, given that workers knew they were being observed; yet the 12-week pre-intervention baseline showed consistently elevated risk levels, a pattern inconsistent with gradual observation-induced behavioural

change. A stepped-wedge or multiple-baseline design across organisational units would permit within-study controls while preserving the ethical commitment to extend the programme to all staff.

Because both PPI and PAT were derived from weekly aggregated records, the analysis could not control for worker-level covariates such as age, tenure, or pre-existing musculoskeletal conditions. This is a common constraint in single-group occupational studies [15]; nesting individual-level symptom data within the time-series framework through multilevel modelling is a natural extension. The multicomponent design also precludes attribution of the PPI reduction to any single programme element — workstation redesign, training, or active breaks — and disentangling these contributions remains a priority for future factorial designs.

The economic evaluation constitutes a distinctive contribution. Vitrano and Micheli observed that the effectiveness of OSH interventions is rarely monitored and frequently assumed without formal assessment [4]; the positive NPV, IRR, and BCR documented here provide concrete return-on-investment evidence for public-sector decision-makers operating under constrained budgets. Taken together, these findings position the present study as an institutional case study that demonstrates the feasibility and measurable benefits of a low-cost ergonomic programme in a Latin-American municipal office, while delineating a clear agenda for confirmatory replication with stronger designs and larger samples.

5. Conclusions

The implementation of a three-component ergonomic intervention programme — combining workstation redesign, structured training, and active breaks — was associated with a large and statistically significant reduction in the proportion of incorrect postures among office workers at a Peruvian municipal sub-directorate. The ITS analysis documented an immediate level change of approximately 59 percentage points at the point of programme implementation, with 90% of the temporal variance in postural risk explained by the model. MSD-related absenteeism declined descriptively by 42%, though this outcome did not reach statistical significance, a result attributable to insufficient statistical power rather than absence of practical effect.

From a practical standpoint, the programme required only standard ergonomic furniture, an eight-week in-house training cycle, and a voluntary active-breaks protocol — resources well within the reach of municipal governments in developing economies. The positive economic evaluation reinforces the viability of this approach for public-sector entities allocating limited occupational safety budgets.

These findings should be interpreted within the constraints of a single-site, five-worker census sample without a concurrent control group. Controlled trials employing stepped-wedge or multiple-baseline designs, with larger and more heterogeneous participant pools, are needed to confirm the magnitude of the effects observed here and to determine whether they are transferable to other municipal and public-sector office contexts.

Abbreviations

BCR, Benefit–Cost Ratio; CI, Confidence Interval; dz, Cohen's d for paired designs; IRR, Internal Rate of Return; ITS, Interrupted Time Series; MSD, Musculoskeletal Disorder; NPV, Net Present Value; OLS, Ordinary Least Squares; OSH, Occupational Safety and Health; PAT, Proportion of MSD-Related Absences; PPI, Proportion of Incorrect Postures; ROSA, Rapid Office Strain Assessment

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