Effectiveness of a workplace physical activity program (WFSIP) for university teaching staff: results of a three-arm randomized controlled trial

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Abstract

The article presents the development and experimental validation of the WorkFit Sitting Intervention Program (WFSIP) — a short, equipment-free, workplace-based physical activity program adapted for the teaching staff of higher education institutions (HEIs) of Uzbekistan. The study was conducted as a three-arm, parallel-group, participant-stratified, single-blinded randomized controlled trial (RCT) reported in accordance with the CONSORT 2010 guidelines, and involved 120 university teaching staff (60 men, 60 women). WFSIP was delivered over six weeks, four sessions per week, 10–15 minutes per session (24 sessions in total), at a Borg RPE intensity of 11–13, and comprised four didactic blocks. The intervention group showed statistically and practically significant improvements across functional indicators (SMT +38.1%, SAET +41.4%, PET +44.9%), physiological indicators (HRrest −6 bpm, HRpost −10 bpm), subjective fatigue (Borg RPE −21.8%) and cognitive–motor performance (WPM +28.3%, error rate −16.1%) (all $p < 0.01$; Cohen's $d = 0.62–1.12$). In the Mixed ANOVA, the Group × Time interaction was highly significant ($p < 0.001$; $\eta^2 = 0.16–0.48$). The study confirms that the WFSIP is an effective pedagogical tool for improving the health and work capacity of university teaching staff.

Keywords: physical activity, workplace program, university teaching staff, sedentary behaviour, randomized controlled trial, WFSIP, professionally-applied physical training, functional endurance.

Introduction

In modern higher education, the professional activity of university lecturers has become increasingly intellectual in nature, with a substantial part of it being carried out in a prolonged sitting position. According to international epidemiological evidence, adults who spend more than seven hours per day sitting are at a significantly elevated risk of cardiovascular disease, type 2 diabetes mellitus and musculoskeletal disorders [9]. In the scientific literature this phenomenon is referred to as “sedentary behaviour” and is now interpreted as an independent risk factor for health, distinct from a general lack of physical activity [13].

A baseline monitoring study conducted by the author from September 2023 to January 2024 in three higher education institutions of the Khorezm region, involving 218 university lecturers, showed that the average daily sitting time of respondents was 8 hours and 24 minutes; 71.2% reported musculoskeletal complaints, and 38.5% exhibited a high level of occupational fatigue. These indicators empirically confirm the practical relevance of the research problem.

In the Republic of Uzbekistan, safeguarding the health of the working-age population is defined as one of the priorities of state policy. In particular, the “Concept of Development of a Healthy Lifestyle and the Public Health System until 2030”, approved by Presidential Decree No. PF-10 of 11 January 2023, identifies the promotion of physical activity among the working-age population as a separate priority area. At the same time, existing national programs are mainly focused on mass sport and work with the younger generation, while no specialized pedagogical programs delivered at the workplace have yet been developed for academic staff engaged in intellectual labour.

Internationally, several workplace physical activity programs — the Intelligent Physical Exercise Training (IPET) study by J.B. Justesen and colleagues [8], the PRESS program by G. Sjøgaard and colleagues [14], and the Stand Up Victoria cluster trial by G.N. Healy and colleagues [7] — have demonstrated their effectiveness. However, most of these studies were conducted on Western office worker samples, and their findings cannot be directly transferred to the context of the higher education system of Uzbekistan. Developing a pedagogically grounded program that takes into account local cultural, professional and organizational specifics is therefore a timely task.

The aim of the present study is to develop and experimentally validate the WorkFit Sitting Intervention Program (WFSIP) — a pedagogical program designed to improve the functional, physiological and cognitive–motor performance indicators of university teaching staff. The working hypothesis is as follows: a short-term, workplace-based physical activity program

built on pedagogical principles, when applied regularly for six weeks, produces significantly greater improvements in functional endurance, cardiovascular indicators, subjective fatigue and cognitive–motor work performance of teaching staff than no intervention or a low-intensity stretching alternative.

Methods

Study design. The study was designed as a three-arm, parallel-group, participant-level stratified, single-blinded randomized controlled pedagogical trial (RCT) with a pre-test / post-test scheme. It was reported in accordance with the CONSORT 2010 [12] and SPIRIT 2013 international recommendations. The compatibility of the terms "pedagogical experiment" and "RCT" ensures that the study meets both traditional pedagogical and modern international scientific standards.

Participants. A total of 120 university teaching staff (60 men and 60 women) took part in the study. Urgench State Pedagogical Institute and Mamun University served as the experimental sites. The sample size was determined a priori using G*Power 3.1.9.7 (Cohen's f = 0.25; $\alpha = 0.05$; $1 - \beta = 0.80$): the minimum total sample for a Mixed ANOVA design was N = 108; allowing for a 10% drop-out reserve, the sample was set at 120. Inclusion criteria were: age 18–59 years, at least one year of pedagogical experience, assignment to the main medical health group, and a daily working time of at least six hours spent in a sitting position. Exclusion criteria included severe cardiovascular and musculoskeletal disorders, pregnancy, and participation in a regular exercise program during the previous six months.

Randomization and groups. Participants were allocated equally to three groups using a computer-based random-number generator stratified by sex (20 men and 20 women per group). The allocation list was concealed using sealed, sequentially numbered opaque envelopes (SNOSE). The intervention group (IG, n = 40) performed the WFSIP program, the active control group (ACG, n = 40) performed low-intensity stretching exercises, and the passive control group (PCG, n = 40) continued their usual activities. The outcome assessors were blinded to group assignment (single-blinding).

Description of the WFSIP program. WFSIP is a six-week, equipment-free, workplace-based pedagogical program comprising 24 sessions (four sessions per week, 10–15 minutes each). The intensity is maintained at a Borg RPE of 11–13 (low-to-moderate). Each session consists of four didactic blocks: (a) dynamic leg exercises performed in a seated position; (b) shoulder-girdle and arm endurance exercises; (c) trunk exercises activating the postural muscles; and (d) breathing and stretching exercises. The program was constructed on the basis of the didactic principles of physical education theory (conscious activity, visual demonstration, systematic progression, individualization, gradual loading), the concept of professionally-applied physical training (PAPT), and the principles of andragogy. To deliver the intervention, six instructors completed 40 hours of specialized training; the fidelity of delivery was monitored for each session using a fidelity checklist.

Outcome measures. Functional status was assessed using three tests performed in a seated position: the Seated Marching Test (SMT — number of steps in one minute), the Seated Arm Endurance Test (SAET — seconds) and the Postural Endurance Test (PET — seconds). Physiological status was assessed by resting and post-exercise heart rate (HRrest, HRpost). Subjective fatigue was measured using the 6–20 -point Borg RPE scale [3], and cognitive–motor performance using a standardized keyboard typing task (words per minute, WPM, and error rate). In a pilot study (n = 18) the tests demonstrated high test–retest reliability (ICC: SMT = 0.91; SAET = 0.89; PET = 0.92).

Statistical analysis. Data were processed using IBM SPSS Statistics 26.0 and Jamovi 2.3. Normality of distribution was tested with the Shapiro–Wilk test, and homogeneity of variances with the Levene test. The primary hypothesis was tested using a Mixed-design ANOVA (3 × 2), with the Group × Time interaction as the focal effect. Practical significance was assessed using Cohen's d and η^2 effect sizes; post-hoc comparisons were performed with Bonferroni correction. Intention-to-Treat (ITT) analysis served as the primary analysis. The significance threshold for all tests was $\alpha = 0.05$. The study was conducted in accordance with the principles of the Declaration of Helsinki; written informed consent was obtained from all participants.

Results and discussion

At baseline (pre-test), the three groups were statistically equivalent on all primary outcomes and demographic indicators (all p >

Table 1. Dynamics of functional indicators (M ± SD)

Test	Group	Pre-test	Post-test	Δ (%)	Cohen's d	p
SMT (steps/ min)	IG	22.3 ± 4.1	30.8 ± 4.6	+38.1	0.98	< 0.001
	ACG	22.1 ± 4.0	24.0 ± 4.2	+8.6	0.22	0.184
	PCG	22.0 ± 4.2	22.2 ± 4.1	+0.9	0.05	0.842
SAET (s)	IG	18.1 ± 3.7	25.6 ± 4.2	+41.4	1.05	< 0.001
	ACG	18.0 ± 3.6	19.2 ± 3.8	+6.7	0.15	0.367
	PCG	18.2 ± 3.8	18.3 ± 3.7	+0.5	0.03	0.912
PET (s)	IG	98 ± 17	142 ± 21	+44.9	1.12	< 0.001
	ACG	97 ± 18	105 ± 19	+8.2	0.18	0.256
	PCG	96 ± 17	97 ± 18	+1.0	0.03	0.864

Note: *Δ (%) — relative change between post-test and pre-test; d — paired Cohen's d; p — paired t-test. IG — intervention group, ACG — active control group, PCG — passive control group.*

0.05), confirming the success of the randomization. The mean age of participants was 36.2 ± 8.0 years, the mean pedagogical experience was 11.6 ± 7.5 years, and the mean daily sitting time was 8.3 ± 0.8 hours. The drop-out rate over the course of the study was low (6 participants, 5.0%) and did not differ between groups.

Functional indicators. As Table 1 shows, after the six-week WFSIP program the intervention group exhibited very strong positive changes on all three functional tests. SMT increased from 22.3 to 30.8 steps/min (+38.1%, d = 0.98), SAET from 18.1 to 25.6 s (+41.4%, d = 1.05), and PET from 98 to 142 s (+44.9%, d = 1.12) (all $p < 0.001$). In the active control group small positive trends were observed but did not reach statistical significance; in the passive control group the indicators remained essentially unchanged. The largest relative gain — on the Postural Endurance Test — indicates that the trunk-exercise block of WFSIP effectively activated the paravertebral and postural muscles that stabilize the spine.

Physiological indicators. In the intervention group, resting heart rate decreased significantly from 76 to 70 bpm (d = 0.68, $p < 0.01$), and post-exercise heart rate from 102 to 92 bpm (d = 0.80, $p < 0.01$). The reduction of the heart rate reserve indicator (Δ HR) from 26 to 22 bpm (d = 0.88, $p < 0.001$) indicates an improved cardiovascular adaptation to a standardized physical load. These findings show that even a short-duration, low-to-moderate intensity exercise complex can produce clinically meaningful cardiorespiratory benefits.

Subjective fatigue and cognitive–motor performance. In the intervention group, the Borg RPE score decreased from 14.2 (close to the "hard" level) to 11.1 (the "light" level) (d = 0.91, $p < 0.001$) — i.e., the same physical load was perceived as substantially easier at the post-test phase. Typing speed, as the quantitative indicator of cognitive–motor performance, increased from 53 to 68 WPM (+28.3%, d = 1.07), while the error rate dropped from 9.3% to 7.8% (−16.1%, d = 0.62). The simultaneous improvement of speed and accuracy (the overcoming of the typical "speed–accuracy trade-off") demonstrates the comprehensive positive impact of the WFSIP program on work performance.

Mixed ANOVA results. Mixed-design ANOVA revealed a highly significant Group × Time interaction ($p < 0.001$) and large practical effect sizes (η^2 range 0.16–0.48) for all primary outcomes. This indicates that the three groups

Table 2. Dynamics of physiological, subjective and cognitive–motor indicators (intervention group, M ± SD)

Indicator	Pre-test	Post-test	Δ	d	p
HRrest (bpm)	76 ± 6	70 ± 5	−6 (−7.9%)	0.68	< 0.01
HRpost (bpm)	102 ± 7	92 ± 6	−10 (−9.8%)	0.80	< 0.01
Δ HR (reserve)	26 ± 5	22 ± 4	−4 (−15.4%)	0.88	< 0.001
Borg RPE (points)	14.2 ± 2.1	11.1 ± 1.7	−3.1 (−21.8%)	0.91	< 0.001
WPM (words/min)	53 ± 7	68 ± 8	+15 (+28.3%)	1.07	< 0.001
Error Rate (%)	9.3 ± 1.8	7.8 ± 1.5	−1.5 (−16.1%)	0.62	< 0.01

followed statistically different trajectories over time — i.e., the effect of WFSIP was clearly distinct from that observed in the control groups. Post-hoc analyses with Bonferroni correction showed that the differences between IG and PCG were significant on all indicators, and that the differences between IG and ACG were significant on most indicators. No significant difference was found between ACG and PCG — confirming that the improvements observed in the IG were not due to chance or a simple "attention effect", but to the specific impact of WFSIP. The Sex × Time ($p = 0.370$) and Age × Time ($p = 0.227$) interactions were non-significant, supporting the universality of the program across demographic subgroups. Sensitivity analyses (ITT and Per-Protocol) confirmed the robustness of the results.

The findings of the study confirm that the WFSIP program produces a comprehensive positive effect on the functional, physiological and cognitive–motor indicators of university teaching staff. Comparing the present results with similar international studies makes it possible to position them within the broader scientific field.

The gains observed for functional indicators (SMT +38.1%, SAET +41.4%, PET +44.9%) are comparable to, or higher than, those reported in the PRESS study by G. Sjøgaard and colleagues [14]. In the PRESS study, 537 office workers performing 20-minute sessions three times per week over 12 weeks showed an average improvement in muscular endurance of 30–35%. WFSIP achieved comparable results in a shorter period (6 weeks) and with less time investment (10–15 minutes per session), which highlights the practical advantage of the program in terms of time efficiency.

The decrease of HRrest by 6 bpm is equivalent to the result obtained after 12 months in the IPET study by J.B. Justesen and colleagues [8], and the fact that WFSIP achieved this in only six weeks is of major importance. According to the comprehensive review by B.K. Pedersen and B. Saltin [11], a 5–10 bpm reduction in HRrest substantially reduces cardiovascular risk, which represents a clinically meaningful outcome for university teaching staff.

The +28.3% gain in cognitive–motor performance empirically supports the theoretical mechanism — established in the meta-regression of J.L. Etnier and colleagues [5] — by which physical exercise improves cerebral blood flow, increases the level of key neurotransmitters and enhances attention and concentration. According to the Cochrane meta-analysis by N. Shrestha and colleagues [15], workplace interventions typically produce moderate effect sizes of $d = 0.30–0.50$; the $d > 0.90$ values obtained in the present study are markedly higher than this international average.

One of the main practical implications of the study is that workplace physical activity programs originally developed for Western office workers can also be effective in the context of the higher education system of Uzbekistan — provided they are fully adapted to local conditions (the professional specifics of teaching staff, work schedules, departmental environment, motivational factors). The fact that WFSIP requires no special equipment, consists of short exercise sessions and can be performed without interrupting work makes it an especially practical option for the national higher education system.

Several limitations should be considered when interpreting the results: as the intervention period was limited to six weeks, the long-term (6–12 months) effectiveness of the program was not assessed; as the study was carried out at two HEIs in one region, generalization to the entire

country requires caution; and some indicators (Borg RPE) are self-reported in nature. At the same time, the RCT design, a priori power analysis, standardized protocols and modern statistical analyses ensure the scientific reliability of the findings. Future research should test the program in a multi-center design and include long-term follow-up.

Conclusion

On the basis of the study findings, the following conclusions can be drawn:

The WorkFit Sitting Intervention Program (WFSIP) — a workplace-based physical activity program adapted to local conditions — has been developed for the first time for the teaching staff of higher education institutions of Uzbekistan, and grounded in the pedagogical principles of physical education theory, the concept of professionally-applied physical training, and the principles of andragogy.

The effect of WFSIP on functional indicators (SMT +38.1%, SAET +41.4%, PET +44.9%; all Cohen's $d > 0.95$) was significantly greater than the effect observed in the control groups.

The program's effects on physiological (HRrest −6 bpm, HRpost −10 bpm), subjective-fatigue (Borg RPE −21.8%) and cognitive–motor performance (WPM +28.3%, error rate −16.1%) indicators confirm its comprehensive pedagogical effectiveness.

In the Mixed ANOVA, the Group × Time interaction was highly significant ($p < 0.001$) and produced large effect sizes for all outcomes; the absence of significant differences between the active and passive control groups supports interpreting the observed effects as directly attributable to WFSIP.

WFSIP achieved an effectiveness comparable to that of established international long-term programs (IPET, PRESS, Stand Up Victoria) in a much shorter period (6 weeks) and with less time investment (10–15 minutes per day), making it a feasible and cost-effective solution for practical implementation in the higher education system of Uzbekistan.

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