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Selected determinants of occupational stress and burnout in physiotherapists and IT professionals

Wybrane uwarunkowania stresu zawodowego i wypalenia zawodowego u fizjoterapeutów i informatyków

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ABSTRACT

Introduction

Occupational stress and burnout have a statistically significant negative impact on learning and work in the professional groups studied, but the exact manner and strength of the impact and the neurophysiological mechanisms underlying the aforementioned phenomena are not yet well understood. The main reason for this is the paucity of research, both on the neurobiological basis and on the incidence and impact on the lives of different professional groups. This complicates both the diagnostic process and subsequent therapeutic management.

Aim of the study

The main objective of the study is to determine the clinical and neurophysiological determinants of occupational stress and burnout, and in particular to investigate whether:
- occupational stress and burnout are related to occupational group,
- the start of professional work already during studies is a significant differentiating factor,
- the nature of work, gender and seniority affect work-related musculoskeletal problems.

Materials and methods

Two groups were recruited for the study: study group (physiotherapists, n = 50), reference group (IT professionals, n = 50). Five clinimetric scales were used in the study:
- Perceived Stress Score (PSS10),
- Maslach Burnout Inventory (MBI), with three subscales,
- Satisfaction with Life Scale (SWLS),
- Minnesota-Short Form Satisfaction with Life Questionnaire (MSQ-SF),

- Nordic Musculoskeletal Questionnaire (NMQ).
The results obtained were subjected to statistical and computational analysis.
Results
Clinical and neurophysiological determinants of occupational stress and burnout relate to statistically significant effects:
- occupation,
- age,
- length of work,
- mode of employment,
- combination of study and work, and multi-work/multi-job.
Conclusions
Stress and burnout are related to the occupational group, with physiotherapists' occupational group experiencing them with greater severity than the IT occupational group. Starting a career already during studies is an important differentiating factor: it increases the risk of stress and professional burnout. The mode of employment, gender and seniority influence work-related musculoskeletal problems: they are experienced more often by the self-employed, men, older people and those with longer work experience.

Keywords: occupational stress, burnout, marker, computational model, virtual patient, digital twin.

STRESZCZENIE
Wprowadzenie
Stres zawodowy i wypalenie mają istotny statystycznie negatywny wpływ na naukę i pracę w badanych grupach zawodowych, ale dokładny sposób i siła oddziaływania oraz mechanizmy neurofizjologiczne leżące u podstaw wymienionych zjawisk nie zostały jeszcze dokładnie poznane. Główną przyczyną takiego stanu rzeczy jest niewystarczająca liczba badań, zarówno w zakresie podłoża neurobiologicznego, jak i występowania oraz wpływu na życie różnych grup zawodowych. Utrudnia to zarówno proces diagnostyczny, jak i późniejsze postępowanie terapeutyczne.
Cel pracy
Głównym celem pracy jest określenie klinicznych i neurofizjologicznych uwarunkowań stresu zawodowego i wypalenia zawodowego, a w szczególności zbadanie, czy:
- stres zawodowy i wypalenie zawodowe są związane z grupą zawodową,
- rozpoczęcie pracy zawodowej już w trakcie studiów jest istotnym czynnikiem różnicującym,
- charakter pracy, płeć i staż pracy wpływają na problemy mięśniowo-szkieletowe związane z pracą.
Materiał i metodyka
Do badania zakwalifikowano dwie grupy: grupa badana (fizjoterapeuci, n = 50), grupa odniesienia (informatycy, n = 50). W badaniu wykorzystano pięć skal klinimetrycznych:
- Perceived Stress Score (PSS10),
- Maslach Burnout Inventory (MBI), with three subscales,
- Satisfaction with Life Scale (SWLS),
- Minnesota-Short Form Satisfaction with Life Questionnaire (MSQ-SF),
- Nordic Musculoskeletal Questionnaire (NMQ).
Uzyskane wyniki badań poddano analizie statystycznej i obliczeniowej.
Wyniki
Kliniczne i neurofizjologiczne determinanty stresu zawodowego i wypalenia zawodowego odnoszą się do istotnych statystycznie efektów:
- wykonywanego zawodu,
- wieku,
- długość pracy,
- sposobu zatrudnienia,
- łączenia nauki i pracy oraz wielozawodowości/wielozawodowości.
Wnioski
Stres i wypalenie zawodowe są związane z grupą zawodową, przy czym grupa zawodowa fizjoterapeutów doświadcza ich z większym nasileniem niż grupa zawodowa informatyków. Rozpoczęcie kariery zawodowej już w trakcie studiów jest ważnym czynnikiem różnicującym: zwiększa ryzyko stresu i wypalenia zawodowego. Sposób zatrudnienia, płeć i staż pracy wpływają na problemy mięśniowo-szkieletowe związane z pracą: częściej doświadczają ich osoby pracujące na własny rachunek, mężczyźni, osoby starsze i z dłuższym stażem pracy.

Słowa kluczowe: stres zawodowy, wypalenie, marker, model obliczeniowy, wirtualny pacjent, cyfrowy bliźniak.

1. Introduction

Occupational stress and burnout have a statistically significant negative impact on study and work in the professional groups studied, but the exact manner and strength of the impact and the neurophysiological mechanisms underlying the aforementioned phenomena have not yet been thoroughly understood [1-3]. Occupational stress and burnout are not new phenomena, but despite the significant number of studies conducted over the past decades, neither their precise definitions nor detailed clinical guidelines have been established. The main reason for this is the insufficient number of studies, both in the area of neurobiological basis and incidence and impact on the lives of various professional groups. This makes both the diagnostic process and subsequent therapeutic management difficult. More research is still needed on both the relationship of occupational stress and burnout to changes in central nervous system structures responsible for emotions and motivation and associated secondary changes, as well as factors that modify the impact of stress and burnout on studies and professional work [4,5]. More research is still needed on both the relationship of stress and burnout to changes in central nervous system structures responsible for emotion and motivation and associated secondary changes, as well as factors modifying the impact of stress and burnout on studies and professional work. The increase in knowledge in the above-mentioned area has important scientific and clinical significance,and the isolation and understanding of the above-mentioned mechanisms will indirectly translate into other areas, such as stress coping strategies [2,3,6]. The increasing pace of life, the socially accepted emphasis on career success, and the relatively early start of work mean that even in occupations considered prestigious and well-paid and providing a sense of security, unfavorable phenomena related to long-term stress and job burnout appear. In addition, the career rush and high employee turnover mean that managerial positions can be filled by employees with relatively short seniority (5-7 years), often unprepared for such mental stress [7,8] and extensive use of the novel technologies [9-11].

The research gap identified relates to how to multidimensionally investigate the prevalence of burnout in two occupational groups: those from the healthcare field and those from the field of work considered to be office-based. This will become very important especially in the coming years in Poland, where an ageing population will require easier and faster access to rehabilitation, which, with a limited number of physiotherapists, will not always be possible, and will certainly burden this professional group, and some professions, including IT specialists, may move to the area of remote work, which is difficult to regulate and control (e.g. under conditions of multi-jobbing). Thus, ultimately, there may be a selection of research tools to suit the specifics of individual professions, as burnout will be the result of different factors.

The novelty brought by the article/research relates not only to the comparison of results across groups, but also to the possibility of their further computational analysis, which will perhaps contribute to distinguishing more detailed mechanisms for the development of burnout, also depending on the occupational group or specific combinations of factors.

The main objective of the study is to determine the clinical and neurophysiological determinants of occupational stress and burnout, and in particular to investigate whether:

- occupational stress and burnout are related to occupational group,
- the start of professional work already during studies is a significant differentiating factor,
- the nature of work, gender and seniority affect work-related musculoskeletal problems.

2. Material and Methods

2.1. Material

The inclusion criteria for the study were age of at least 18 years and working in the profession for at least recent 12 months. The subjects were not required to have a university degree, as this is not required to work in the IT profession, and until recently (until the introduction of the Law on the Profession of Physiotherapist) physiotherapists also completed a bachelor's degree, and before that: a medical vocational college. Two groups were qualified for the study: group 1 (physiotherapists, n = 50), group 2 (IT professionals, n = 50) (Table 1, Figure 1).

Table 1. Sample characteristics.

	Group 1 (physiotherapists) (n=50, 100%)	Group 2 (informaticians) (n=50, 100%)
Age [years]:		
Mean	27.88	28.44
SD	4.17	4.79
Min	22	22
Q1	24	23
Median	26	26
Q3	30	29
Max	34	35
Seniority [years]:		
Mean	4.20	5.36
SD	1.61	1.53
Min	1	1
Q1	1	2
Median	4	5
Q3	7	8
Max	10	13
Gender:		
Female (F)	30 (60%)	30 (60%)
Male (M)	20 (40%)	20 (40%)

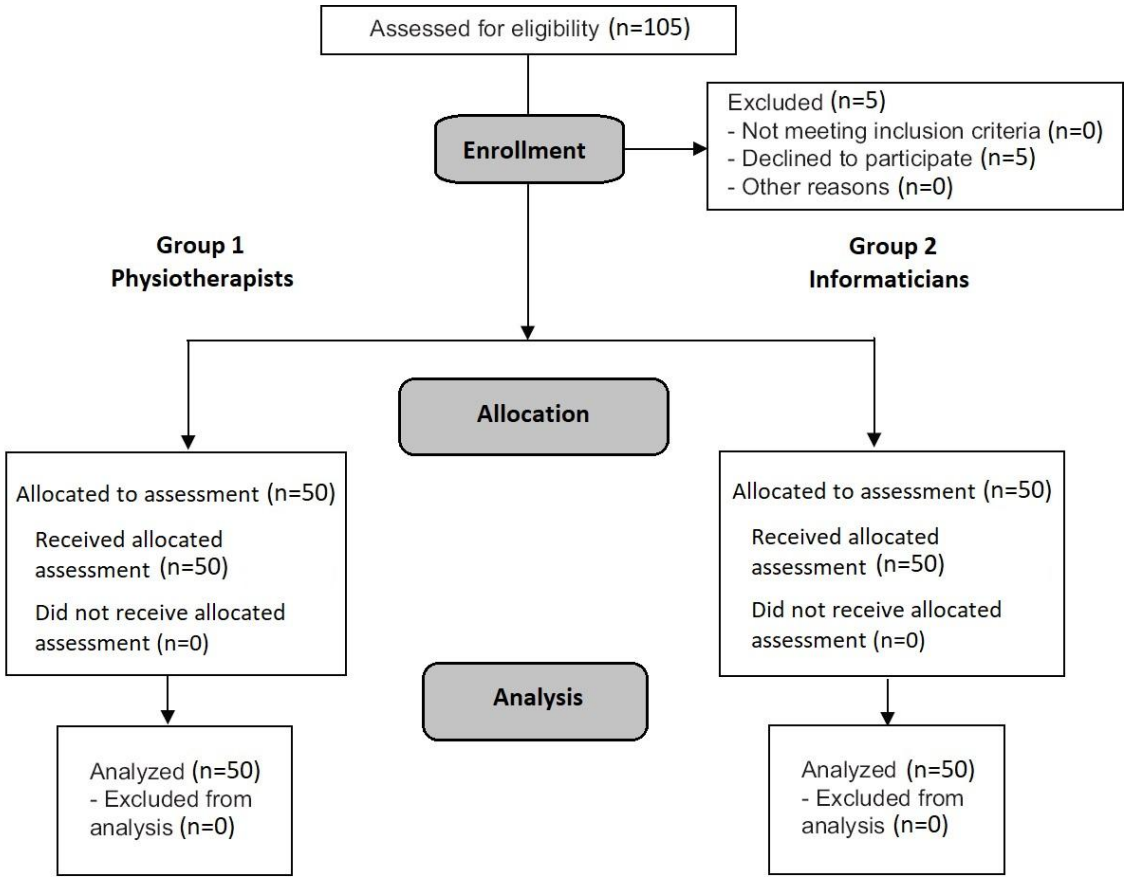

Figure 1. Patient flow diagram.

The study is covered by the approval of the Bioethics Committee No. KB 391/2018 at the Ludwik Rydygier Medical College in Bydgoszcz Nicolaus Copernicus University in Toruń.

2.2. Methods

The study used five clinimetric scales (Table 2):
- Perceived Stress Score (PSS10),
- Maslach Burnout Inventory (MBI), in three subscales,
- Satisfaction with Life Scale (SWLS),
- Minnesota Satisfaction Questionnaire-Short Form (MSQ-SF),
- Nordic Musculoskeletal Questionnaire (NMQ).

The multiple scales used in the study result in a more accurate reflection of the possible causes of high stress and burnout against the perceived Job satisfaction and quality of life.

Table 2. Characteristics of scales used in the study.

Test	Direction of change	Score
PSS10	higher score means more stress	1-4: low 7-10: high
MBI		three subscales: emotional exhaustion (EE) (9), depersonalization (DP) (5) and personal achievement (PA) (8)
SWLS	higher score means higher quality of life	score range 5-35, with: 5-9 extreme dissatisfaction with life, 20 - neutral, 31-35 - extreme satisfaction with life
MSQ-SF	higher score means higher job satisfaction	20-100 at least 50 means job satisfaction
NMQ	higher score means higher number of health problems	whether the patient has problems with locomotion and how often

An original questionnaire was also used to collect demographic and organisational data (gender, age, seniority, education, place of work, etc.).

2.3. Statistical analysis

The results were recorded in an MS Excel spreadsheet and statistically analyzed using Statistica 13 (StatSoft, Tulsa, USA). The normality of the data distribution was checked each time using the Shapiro-Wilk test ($\alpha = 0.05$). Values for distributions close to the normal distribution were presented by mean value and standard deviation (SD). Values for distributions deviating from the normal distribution were presented by median, minimum value, maximum value, and lower quartile (Q1) and upper quartile (Q3). Spearman's rank correlation coefficient (rho Spearman) was used for correlation analysis. Statistical calculations were performed using ANOVA (analysis of variance) with the Tuckey test post-hoc test applied where appropriate. Significance was set at the $p < 0.05$ level.

2.4. Computational Analysis

Computational analysis methods used (also described in further publications [12-18]):
- multicriteria analysis (MCA) of medical data,
- artificially intelligent models - machine learning - based on artificial neural networks,
- artificially intelligent models - based on fuzzy logic,
- multifractal analysis, including fractal dimension for uniformity analysis and Hurst exponent for trend analysis.

Software used:
- Matlab R2022b (Mathworks, USA),
- ELECTRE Tri 2.0 (ELimination and Choice Expressing REality).

3. Results

The study observed statistically significant and reflected in the results and computational models greater work-related stress, greater job burnout and lower life satisfaction in the physiotherapist occupational group compared to the IT professionals, across all age groups, length of tenure and gender (Table 3 and 4, Figure 2).

Table 3. Results for group 1 and group 2.

Scale	PSS10	MBI	SWLS	MSQ-SF	NMQ
Group 1 (physiotherapists)					
Mean	5.43	49.24	16.31	33.57	0.71
SD	1.89	14.47	4.57	6.99	0.54
Min	2	32	12	22	0
Q1	3	38	14	27	0
Median	6	46	20	35	1
Q3	8	55	22	44	1
Max	9	79	25	57	2
Distribution	not normal	not normal	not normal	not normal	not normal
Group 2 (IT professionals)					
Mean	4.22	16.34	28.43	52.11	0.43
SD	1.17	3.07	2.89	14.33	0.51
Min	2	14	24	25	0
Q1	3	15	28	38	0
Median	4	17	28	54	0
Q3	6	19	32	67	1
Max	7	24	34	77	1
Distribution	normal	not normal	not normal	not normal	not normal
p-value	0.021	0.007	0.004	0.005	0.035

The overall results of the study indicate that higher stress, lower quality of life, lower job satisfaction and a higher reported number of musculoskeletal injuries were observed in the physiotherapist group (mean 0.71 in physiotherapists vs. 0.43 in IT professionals) (Table 4). These injuries in the physiotherapist group mainly involved the upper back, upper back, and elbows and in the IT group: neck and wrists/hands. Such location of injuries is justified by the loads generated by the performed professions. In a study using MBI, greater emotional exhaustion (EE) and depersonalization (DP) were observed in the group of physiotherapists (EE: 21.17±9.42, DP:5.43±2,11), and better personal accomplishment (PA: 36.57±4.23) in the group of IT specialists.

Table 4. General results in the study (only statistically significant changes included).

Scale	PSS10	MBI	SWLS	MSQ-SF	NMQ
Values in group 1 (physiotherapists)	higher stress	higher stress	lower quality of living	lower job satisfaction	higher number of problems
Values in group 2 (IT professionals)	lower stress	lower stress	higher quality of living	higher job satisfaction	lower number of problems

The study observed statistically significant and reflected in the results and computational models greater work-related stress, greater job burnout and lower life satisfaction in the older respondents (above the median) compared to the younger group, in both professional groups regardless of gender (Table 5, Table 6).

Table 5. Results for group 1 (physiotherapists) by age: younger (below the median age) vs. older (equal to and above the median age).

Scale	PSS10	MBI	SWLS	MSQ-SF	NMQ
younger (below the median age)					
Mean	4.14	43.44	19.46	42.58	0.61
SD	1.16	12.11	3.92	7.41	0.22
Median	5	43	21	46	1
older (equal to and above the median age)					
Mean	7.22	53.21	14.16	31.37	0.76
SD	1.43	16.12	4.29	7.22	0.53
Median	7	52	17	33	1
p-value	0.012	0.027	0.043	0.007	0.033

Table 6. Results for group 2 (IT professionals) by age: younger (below the median age) vs. older (equal to and above the median age).

Scale	PSS10	MBI	SWLS	MSQ-SF	NMQ
younger (below the median age)					
Mean	3.17	13.23	32.54	62.34	0.21
SD	1.21	3.08	3.65	12.11	0.34
Median	3	14	33	61	0
older (equal to and above the median age)					
Mean	5.47	20.23	24.16	46.67	0.51
SD	1.87	3.97	2.97	12.32	0.45
Median	5	19	24	45	1
p-value	0.029	0.033	0.007	0.009	0.024

In the group of older physiotherapists (above the median), this may be due to the physical fatigue as well as mental fatigue generally observed in the health professions. In the group of IT specialists, this may be due to a different attitude to success: the respondents belonged to the population of Polish IT specialists, among whom early Silicon Valley-like retirements are not common in Polish conditions, and different financing, work culture and employment conditions may be conducive to some of the most dynamic IT specialists leaving to work abroad. This is also true for the most dynamic physiotherapists, but in a different way: for IT specialists, it is often remote work abroad, while for physiotherapists, the decision is more difficult, involving a move and all its professional and family consequences.

The study observed statistically significant and reflected in the results and computational models greater work-related stress, greater job burnout and lower life satisfaction in men compared to the women's group, in both professional groups regardless of age and gender (Table 7, Table 8). Lower musculoskeletal pain in physiotherapists women may be partly due to the limitations of their heavy lifting at work.

Table 7. Results by gender for physiotherapists.

Scale	PSS10	MBI	SWLS	MSQ-SF	NMQ
Male					
Mean	7.23	53.87	14.32	30.16	0.82
SD	1.34	15.22	4.32	5.99	0.55
Median	7	53	17	32	1
Female					
Mean	4.84	43.11	19.11	37.39	0.63
SD	1.69	13.56	5.89	7.22	0.54
Median	5	43	22	38	1
p-value	0.043	0.019	0.006	0.001	0.037

Table 8. Results by gender for IT professionals.

Scale	PSS10	MBI	SWLS	MSQ-SF	NMQ
Male					
Mean	5.23	20.21	25.13	47.88	0.41
SD	1.41	4.65	4.66	13.28	0.44
Median	5	20	24	48	0
Female					
Mean	3.57	12.99	32.11	57.23	0.48
SD	1.12	3.89	2.17	17.11	0.21
Median	3	13	32	58	0
p-value	0.017	0.023	0.011	0.007	0.039

The study observed statistically significant and reflected in the results and computational models greater work-related stress, greater job burnout and lower life satisfaction in those with longer tenure (above the median length of tenure) compared to the group with shorter tenure, in both professional groups regardless of gender (Table 9, Table 10). Longer seniority can promote job burnout similarly to older age.

Table 9. Results by senioraty for physiotherapists.

Scale	PSS10	MBI	SWLS	MSQ-SF	NMQ
Shorter seniority (below the median seniority)					
Mean	4.46	42.11	21.17	38.15	0.61
SD	1.29	13.48	4.84	6.57	0.34
Median	4	42	22	39	1
Longer seniority (equal to and above the median the median seniority)					
Mean	7.13	52.12	14.23	29.76	0.89
SD	1.49	15.34	4.17	5.69	0.43
Median	7	51	15	30	1
p-value	0.013	0.022	0.003	0.007	0.021

Table 10. Results by senioraty for IT professionals.

Scale	PSS10	MBI	SWLS	MSQ-SF	NMQ
Shorter seniority (below the median senioraty)					
Mean	3.15	13.13	32.22	58.46	0.31
SD	1.12	3.88	4.11	16.18	0.44
Median	3	13	32	56	0
Longer seniority (equal to and above the median the median seniority)					
Mean	5.38	21.34	24.12	48.29	0.53
SD	1.34	3.89	5.87	12.59	0.45
Median	5	20	24	48	1
p-value	0.007	0.005	0.009	0.012	0.037

The study observed statistically significant and reflected in the results and computational models greater work-related stress, greater job burnout and lower life satisfaction in those combining education with work, in both professional groups (greater negative impact in the physiotherapist group), regardless of gender (Table 11, Table 12). In both groups, course training (shorter, cheaper, more readily available to working people) predominated, less so additional study, which requires a longer time commitment. Vocational courses are a typical form of further training in both professional groups surveyed, often required by the employer but financed by own resources. In the group of physiotherapists, there is an additional specialisation as another professional title after the master's degree.

What we can say is that safety takes time - where we are in a hurry, where we are constantly short of time, safety attention decreases and more injuries occur, and the time pressure and stress is greater.

Table 11. Results by combining education and work for physiotherapists.

Scale	PSS10	MBI	SWLS	MSQ-SF	NMQ
Participants combining education and work					
Mean	7.11	52.33	13.27	27.43	0.88
SD	1.67	14.67	4.56	7.49	0.55
Median	7	52	14	28	1
Participants not combining education and work					
Mean	4.34	42.43	19.24	37.21	0.65
SD	1.09	12.34	3.89	7.43	0.44
Median	4	42	19	39	1
p-value	0.031	0.019	0.011	0.014	0.029

Table 12. Results by combining education and work for IT professionals.

Scale	PSS10	MBI	SWLS	MSQ-SF	NMQ
Participants combining education and work					
Mean	5.56	20.28	25.11	47.39	0.56
SD	1.13	4.89	5.65	13.21	0.42
Median	5	20	25	45	0
Participants not combining education and work					
Mean	3.29	13.22	32.13	58.17	0.34
SD	1.11	3.55	3.65	16.71	0.22
Median	3	13	31	57	0
p-value	0.034	0.005	0.001	0.007	0.022

The study observed statistically significant, and reflected in the results and computational models, greater work-related stress, greater job burnout, and lower life satisfaction in self-employed compared to salaried employees, in both professional groups, regardless of gender (Table 13, Table 14). No doubt self-employment is a form of economic activity that requires more commitment, more time and sometimes risks.

Table 13. Results by type of work for physiotherapists.

Scale	PSS10	MBI	SWLS	MSQ-SF	NMQ
Self-employed or combining jobs					
Mean	7.22	53.21	13.36	26.23	0.83
SD	1.43	16.12	4.97	6.89	0.32
Median	7	52	14	27	1
Salaried employees (one place of work)					
Mean	4.14	43.44	20.01	37.13	0.55
SD	1.16	12.11	4.94	7.21	0.43
Median	5	43	20	38	1
p-value	0.035	0.009	0.005	0.003	0.041

Table 14. Results by type of work for IT professionals.

Scale	PSS10	MBI	SWLS	MSQ-SF	NMQ
Self-employed or combining jobs					
Mean	5.47	20.23	24.89	46.22	0.47
SD	1.87	3.97	5.13	12.87	0.43
Median	5	19	25	45	0
Salaried employees (one place of work)					
Mean	3.17	13.23	31.18	57.23	0.33
SD	1.21	3.08	6.11	17.96	0.22
Median	3	14	31	56	0
p-value	0.017	0.005	0.001	0.003	0.023

Combining jobs (full-time primary employment and supplementary employment in various forms, including self-employment) was quite common in both groups (48% in the physiotherapist group and 32% in the IT group) and in both groups significantly higher than the national average (20% among employed and 12.6% among retired). Combining jobs (full-time primary employment and supplementary employment in various forms, including self-employment) was quite common in both groups (48% in the physiotherapist group and 32% in the IT group) and in both groups significantly higher than the national average (20.0% among employed and 12.6% among retired). No single dominant form of multi-jobbing was observed, indicating multiple opportunities to combine earnings. Nevertheless, there is no doubt that such work is more damaging to health, causes greater occupational stress and possibly earlier burnout due to the need for better planning of the day or week and reduced time for rest. However, for the majority of respondents such work was a financial necessity. The survey was conducted before inflation and the increase in lending rates, so a worsening of the situation in this area, i.e. an increase in the number of people working in addition to their basic job, is to be expected. Interestingly, more physiotherapists (12%) than IT Professional (2%) are also working academically (in various forms) - it can be concluded from this that a PhD among physiotherapists has a greater impact on career progression than among IT professionals, where typically formal education is less important and is mainly needed for promotion to management positions above project manager.

Significant differences in correlations were observed: in the physiotherapist group, statistically significant correlations were observed between MBI and PSS10, MBI and SWLS, MBI and MSQ-SF, SWLS and MSF-SF scores, while in the IT group, statistically significant correlations were observed between NMQ and MBI, NMQ and SWLS, NMQ and MSQ-SF, NMQ and PSS10, SWLS and MSF-SF stores (Table 15).

Table 15. Correlations between tests results for group 1 and group 2.

Scale	PSS10	MBI	SWLS	MSQ-SF	NMQ
Group 1 (physiotherapists)					
PSS10	-	0.542 p=0.011	n.s.	n.s.	n.s.
MBI	0.542 p=0.011	-	n.s	n.s	n.s.
SWLS	n.s.	n.s.	-	0.842 p=0.001	n.s.
MSQ-SF	n.s.	n.s.	0.842 p=0.001	-	n.s.
NMQ	n.s.	n.s.	n.s.	n.s.	-
Group 2 (IT professionals)					
PSS10	-	n.s.	n.s.	n.s.	0.319 p=0.015
MBI	n.s.	-	n.s	n.s	-0.354 p=0.026
SWLS	n.s.	n.s.	-	0.812 P=0.005	0.794 p=0.007
MSQ-SF	n.s.	n.s.	0.812 P=0.005	-	0.743 p=0.000
NMQ	0.319 p=0.015	-0.354 p=0.026	0.794 p=0.007	0.743 p=0.000	-

This indicates differences between the groups of physiotherapists and IT professionals in defining what wellbeing and job burnout mean to them. The interesting positive correlation of SWLS, MSQ-SF and NMQ may indicate that greater workload in overworked IT professionals resulting in greater trauma translates into higher earnings. Such a result, if confirmed in subsequent studies, may require modification of the methodology of further research, taking into account whether satisfaction is from the physical conditions of the job, earnings or other factors (e.g. opportunities to work remotely from tourist attractions with higher earnings - so-called workation).

The survey data were prepared in such a way that they can be used in computational models (including the patient's digital twin) later in the publication cycle and the construction of further, more accurate computational models [12-18].

4. Discussion

The results of the research conducted are interesting, comprehensive and statistically significant. They can provide both a basis for replication of the research in the same occupational groups and a starting point for extension to new occupational groups, larger groups or other ways of studying and analysing the results. To some extent, they may also inspire the development of further computational solutions to support data collection and analysis, similar to 'Artificial-intelligent device to support diagnosis of mild cognitive disorders' (Primary investigator: J. Masiak, inwestigator: D. Mikołajewski) and our other studies [12-18].

4.1. Reference to results of other studies

The analysis of the literature showed that, in the professional group of physiotherapists, occupational stress and burnout can have a significant, currently underestimated, negative impact on their health and performance at work. Most of the data need further confirmation in future studies due to methodological, legal and cultural differences. Action is needed to reduce the prevalence of the aboremention pathologies, including through the implementation of stress prevention and management strategies that raise awareness among both physiotherapists themselves and managers of healthcare organisations [19-22]. The variation in research methods does not allow for a direct comparison of partial results, but it is worth comparing the final results and conclusions. Wójtowicz & Kowalska's study included 170 professionally active physiotherapists: 100-post-pandemic and 70 pre-pandemic COVID-19. The study used the author's questionnaire, the Subjective Work Assessment Questionnaire (SWAQ), the Oldenburg Burnout Inventory (OLBI), the Perceived Stress Scale (PSS-10) and the Brief Coping Orientation to Problems Experienced (Mini-COPE). It was observed that the factors resulting in increased occupational stress in both study groups were social interactions, lack of support and lack of rewards at work. This shows that physiotherapists were exposed to occupational stress and burnout both before and during the pandemic. Furthermore, the identification and elimination of all the above risk factors is required as part of prevention programmes in this occupational group [23]. Szwamel et al. surveyed 497 healthcare professionals from across Poland using the Maslach Burnout Inventory (MBI), the Hospital Anxiety and Depression Scale (HADS) and the World Health Organization Quality of Life Instrument Short Form (WHOQOL BREF). Higher emotional exhaustion was observed in nursing and 'other' medical staff than in physiotherapists. Risk factors included severity of depression, problems in the physical, psychological and/or social domain of life, support provided by the employer, age and material status. It was emphasised that, as part of prevention, it is crucial to ensure employer support, satisfactory earnings, early recognition of depressive symptoms and undertaking treatment [24]. In the study by Kowalska et al. 70 physiotherapists were surveyed using the author's questionnaire, the Subjective Job Evaluation Questionnaire, the Oldenburg Occupational Burnout Inventory, the Perceived Stress Scale and the Mini-COPE Stress Coping Strategy Measurement Inventory. Moderate levels of stress, high levels of occupational stress and moderate levels of occupational burnout were observed in the study group. Identified stress triggers included social interactions, uncertainty, feelings of insecurity and lack of control due to workplace organisation and lack of rewards at work [25]. A study by Puhanić et al. on 404 Croatian physiotherapists used a socio-demographic questionnaire, Job Descriptive Index (JDI) and Oldenburg Burnout Inventory (OLBI). Respondents showed high levels of job satisfaction and job burnout, but higher levels of job burnout were associated with lower job satisfaction. While the factors for job satisfaction were younger age, female gender, shorter job tenure and being in a relationship (married or partnered), the factors for higher levels of job burnout were working in government institutions and being single [26]. In a study by Carmona-Barrientos et al. 272 Spanish physiotherapists were surveyed in terms of socio-demographic variables, working conditions, occupational stress levels and occupational burnout. It was observed that 30.51% of physiotherapists felt a high level of occupational stress, and 34.56% - its average level. In addition, a relationship was noticed between a high level of stress and the feeling of stress during the period of academic training, temporary work with over 10 years of professional experience. Overall low levels of burnout with high levels of emotional exhaustion (EE) were also observed. The level of EE was significantly correlated with job change, willingness to study, stress and inadequate academic preparation, and stressful work. The correlations indicate that a high level of stress can lead to burnout, hence the need to implement stress coping strategies faster in this professional group [27]. A study by Wrzesińska et al. assessed the level of burnout and quality of life (QoL) among 43 Polish blind and visually impaired masseurs. The sociodemographic data questionnaire, Maslach Burnout Inventory-General Survey and WHOQOL-BREF were used in the study. It was observed that in the professional group of visually impaired masseurs, professional activity plays a key role in psychosocial rehabilitation, with a low risk of professional burnout and the highest quality of life in the psychological domain [28]. In a study by Petrelli et al. the Maslach Burnout Inventory (MBI) and a healthcare worker lifestyle questionnaire were used. The highest incidence of depersonalization was observed, followed by emotional burnout. They were strongly correlated with drinking alcohol and smoking and working in the same job for at least 15 years [29]. The previous observations were confirmed by a qualitative systematic review by

Koontalay et al. of five databases (from November 2020 to February 2021). The review showed inadequate preparation, emotional challenges, inadequate equipment and information, and burnout related to the COVID-19 pandemic and related challenges experienced by 498 doctors, nurses, physiotherapists, paramedics and support staff [30]. Review by Sorenson et al. showed that while compassion fatigue (CF) and related concepts (RC) have been studied in large groups of physicians, there are few publications on nurses, physiotherapists, and occupational therapists. Further research should focus on the personal and professional well-being of all medical staff, including patient interactions and quality of working life. This may have an impact on keeping this group of specialists in the profession [31]. A study by Lau et al. showed the experience of physiotherapists working in acute hospitals. It identified factors influencing physiotherapists' experience and clinical decision-making: environmental/contextual, communication/relationship, personal, and identity/professional role. They indicate the need to include in prevention strategies: promotion of interprofessional relations, clear definition of the role of the physiotherapist, multidisciplinary education, support staff and innovative models of care [32]. Review by Ishaky et al. showed that in future emergencies such as a pandemic, providing timely and accurate health information to healthcare professionals is crucial, and will translate into improved mental health outcomes, including stress and burnout [33]. A review by Weenink et al. showed that despite including 38 studies on remediation and rehabilitation for healthcare professionals with performance problems (dentists, midwives, nurses, pharmacists, doctors, physiotherapists, psychologists and psychotherapists), comparisons of outcomes between professions and specific performance problems cannot be made. The positive results of such programmes are mainly for doctors, mostly in the USA [34]. An analysis of factors favouring the development of professional burnout among 200 Polish physiotherapists conducted by Sliwiński et al. using a questionnaire to collect socio-demographic data, the Satisfaction with Life Questionnaire (LSQ), and the Burnout Scale Inventory (BSI) showed significant differences in life satisfaction between job tenure groups and factors for the development of professional burnout. Physiotherapists with seniority of more than 15 years experience more burnout when working in a work environment other than a health or education centre. In addition, satisfaction with their profession, job satisfaction and a fulfilling family life and friends prevent professional burnout among physiotherapists with 5-15 years of seniority in the profession. Interestingly, financial satisfaction, age and employment in healthcare may be the cause of professional burnout not so much in the oldest group, but among physiotherapists with an average length of service of 5-15 years. The implication is that burnout prevention strategies should be differentiated according to the length of service in the physiotherapy profession [35] Gender variation was also observed. Among men, lack of leisure time contributes to an increased risk of burnout, while satisfaction with marriage, partnership and children, work and occupation, interactions with friends, relatives and acquaintances and sexuality contributes to a decreased risk. Among women, poor material circumstances contribute to an increased risk of burnout, and to a decreased risk: satisfaction and family, children, health, leisure time and interaction with friends, relatives and acquaintances [36]. The study by Owczarek et al. on 212 physiotherapists with various years of experience and of different ages, using their own burnout questionnaire, showed lower results in this group than those obtained in other professional groups of health care workers, while in the group of physiotherapists, burnout was higher in women. Professional burnout was also caused by working conditions that made it difficult to achieve therapeutic success, such as insufficient quality of equipment or the size of treatment rooms [37]. A survey of 100 physiotherapists in India found a self-reported work-related MSD prevalence of 92%, affecting daily activities and sometimes even changing jobs. Factors influencing the development of work-related pain symptoms were: gender, physiotherapist's specialization, office equipment and time of contact with the patient [38]. An attempt to explain the relationship between locus of control at work and burnout in Polish physiotherapists through the mediation of coping styles based on self-report data of 155 Polish physiotherapists showed that physiotherapists in difficult-to-manage situations become burnt out when they use coping strategies focused on emotions and less on problem. Strategies for countering stress should include an emphasis on problem-focused training in coping with stress and increasing the sense of control over the situation [39]. This sums up the study by Pustułka-Piwnik et al. on 151 Polish physiotherapists with at least 3 years of work experience, using the Maslach Burnout Inventory (MBI) questionnaire showed that occupational burnout among physiotherapists is manifested by increased emotional exhaustion and a reduced sense of personal achievement. The factors of increased emotional exhaustion were working with adults and employment in hospitals, the factors of increased depersonalization were male gender, hospital work and longer tenure (15 to 19 years), the factors of reduced personal achievement were male gender and lower education. Such results, however, require further research to identify and implement elements of prevention [40].

A review by Berg-Beckhoff et al. summarised quantitative research on the relationship between information and communication technology (ICT) and occupational stress and burnout. The association of ICT use in the work environment with stress was observed in cross-sectional studies, but not in intervention studies, An association with ICT and burnout was also observed, mainly in the middle-aged employee population, which requires further research [41]. Since the 1990s, it has been thought that intensive computer work could cause carpal tunnel syndrome (CTS), but this association has not yet been proven. In the study by Lewanska et al. 60 subjects worked with a computer for an average of 6.43 (SD=1.71) hours per day (and thus incomplete 8 hours), and the

period between the start of work and the onset of the first symptoms of CTS averaged 12.09 (SD=5.94) years. Assessment of risk factors for the development of CTS in this population showed non-occupational factors such as obesity, diabetes, hypothyroidism, oophorectomy, hormone replacement therapy, oral contraceptives, history of hysterectomy, menopause and tendinitis. In contrast, no association of CTS with occupational factors was demonstrated [42]. Interestingly, a study by Kaliniene et al. using the Nordic Musculoskeletal Questionnaire and Copenhagen Psychosocial Questionnaire and direct observation showed that as many as 65.7% of 513 public sector office workers working with computers complained of musculoskeletal disorders (MSDs). Furthermore, MSDs of the neck were associated with individual factors and working conditions, especially working for more than two hours without a break, older age, longer work experience, high demands, and higher ergonomic risk. This shows where preventive action should be targeted in this group of workers [43]. A review by Malińska showed that sedentary work can be the cause of many MSDs among computer operators. MSDs were divided into work-related problems (occupational diseases), problems associated with work (para-occupational diseases) and caused by on-occupational diseases factors (age, gender, social and family situation, lifestyle, etc.). They are more at risk of developing these ailments women [44]. In addition, computer users can expand at home damage to the median and ulnar sensory nerves in the wrist area, which can cause deficits associated with increased use of the dominant side. Further research is needed, including the most effective method of prevention in this area [45]. A study conducted in Italy on 631 women aged 38.14±7.81 years working at least 20 hours a week on a computer showed that the prevalence of CTS in the study group is similar to the estimates for the general Italian population, hence CTS is rather work-related a musculoskeletal disorder, not an occupational disease. Risk factors were: hormone therapy, history of upper limb injury and signs/symptoms of the cervical spine [46].

4.2. Limitations of own research

A significant limitation of this study may be the small sample size, but it is comparable to the lower limits for this type of study.
The research combines the results of quantitative tests (like the NMQ) with information on the patient's subjective feelings about life satisfaction, which, through a decision-making method, will assist clinicians in making decisions. further, however, it remains only a second-opinion system, and the burden of decision rests with the individual.
Although multiple scales were used for the study, the study did not use descriptive criteria such as feelings of equality or social justice due to the difficulty of defining them and the lack of sufficient interview data. Thus, social tasks or the patient's family situation were not taken into account when qualifying for burnout risk.
Technological limitations in the field of information technology are surmountable with the development of artificial intelligence. Artificial intelligence-based tools can improve insights into both the neurophysiology of stress and occupational burnout, as well as the analysis, prediction and assessment of the potential for trend change.
However, key limitations in this area of research and clinical practice may still be due to ignorance and low acceptance of this group of solutions by both patients and their families and clinicians.

4.3. Directions for further research

The primary direction for further research is to develop and validate a test procedure for assessing burnout - this will allow the patient's qualification as a second opinion to be accurately determined.
The concept of objectifying the results of diagnosis and therapy of occupational burnout and work-related stress also combines a number of current and future design and simulation approaches:
- the impact of telemedicine and telerehabilitation on patient welfare and well-being,
- affective informatics, i.e., the recognition of emotions by devices and reacting not according to social rules,
- the use of digital twins of the patient, including in the emotional area,
- objectification of all areas of clinical activity: from physiotherapy to modeling the functioning of the central nervous system.

The impact of the threat to their jobs from low-code and no-code AI systems could be an interesting follow-up to the research on occupational stress and burnout in the IT group.
Decision-making alone does not determine the success of the chosen therapeutic approach. The growing emphasis on the use of experimentally proven diagnostic and therapeutic methods, techniques and devices requires their continuous verification by teams of medical specialists, including in laboratory and clinical settings, within the paradigm of Evidence Based Medicine (EBM).
Results of two our grants: 'Artificial-intelligent device to support diagnosis of mild cognitive disorders' and POIR.01.01.01-00-0272/18 "System of computer unsupervised psychotherapy of depression" may be useful testing environment and insiration for familiy of similar solutions. Further inspiration for further research may

come from publications on the aftermath of the pandemic in both adults and children - this includes not only health implications, but also changes in work organisation, including greater use of remote working [47,48].

5. Conclusions

The nature of physiotherapists' work is associated with an increased risk of occupational stress and burnout. The work of IT professionals also carries a risk of burnout, but much less. Clinical and neurophysiological determinants of occupational stress and burnout relate to statistically significant effects:
- occupation,
- age,
- length of work,
- mode of employment,
- combination of study and work, and multi-work/multi-job.

Stress and burnout are related to the occupational group, with physiotherapists' occupational group experiencing them with greater severity than the IT occupational group. Starting a career already during studies is an important differentiating factor: it increases the risk of stress and professional burnout. The mode of employment, gender and seniority influence work-related musculoskeletal problems: they are experienced more often by the self-employed, men, older people and those with longer work experience.

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