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Reducing work-related stress among health professionals by using a training-based intervention programme for leaders in a cluster randomised controlled trial

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Healthcare organisations worldwide are affected by the shortage of health professionals due to work-related stress and health professional leaders play an important role by implementing effective strategies. Therefore, this study aims to investigate whether the STRAIN intervention program (using evidence-based training for health professional leaders) can reduce work-related stress among health professionals. This study is based on a cluster randomised controlled trial, consists of three measurements and includes 165 participating hospitals, nursing homes and home care organisations. A total of 206 health professional leaders took part in the intervention programme and 19,340 health professionals participated in the study. Results showed no significant differences ($p > 0.05$) between the intervention and control group regarding the effort-reward imbalance ratio, quantitative demands, opportunities for development, bond with the organisation, quality of leadership, social community, role clarity, rewards, difficulties with demarcation and work–private life conflict. Pre-/post-test analysis revealed a tendency for significant positive results ($p < 0.05$) for stressors, stress symptoms and long-term consequences for organisations with a leaders' participation rate of $\geq 75\%$. Leaders' awareness, commitment and readiness is essential to implement effective strategies reducing work-related stress.

Keywords Work-related stress, Health professionals, Training-based intervention, Leaders, Randomised controlled trial

Healthcare systems around the world are struggling with a workforce shortage of health professionals[1]. A shortage of qualified health professionals goes along with a decreasing availability and quality of care provided and an increasing of patient mortality[1–3]. The COVID pandemic is the best example of this[4]. But even before that pandemic, many health professionals left their profession prematurely[5,6]. In Switzerland, more than 30% of physicians left direct patient care and more than 40% of nurses and medical-technical professionals left their profession prematurely[5].

Some of the main reasons why health professionals leave their profession prematurely are work-related stress, effort–reward frustration and poor working conditions[7–9]. In addition, high levels of stress at work are associated with health professionals' job dissatisfaction, increasing absenteeism rates and a higher intention to leave their profession prematurely[10–12]. Work-related stress can be explained as 'a pattern of reactions that occur when workers are confronted with demands or pressures (stressors) that are not matched to their knowledge, abilities and skills, and which challenge their ability to cope'[13,14]. Health professionals are affected by various stressors at

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work, such as high emotional demands due to confrontation with suffering, death or aggression, high physical demands by lifting or moving people, a high workload, understaffing, poor leadership and work–private life conflicts e.g. due to shift work, long working hours and doing overtime[11,15–17].

Several studies concluded that there is a need for more research on interventions that focus on work stressors and improving working conditions regarding the retention of health professionals in their jobs[5,7,10,18]. Therefore, it is important to develop intervention and prevention strategies addressing the most salient stressors among health professionals[19]. Health professional leaders in all hierarchies play an important role in reducing stressors at work and achieving a healthy work environment[20–23]. Their significant commitment to implementing effective prevention and intervention strategies, their shaping of culture within the organisation as well as their behaviour, skills and abilities are important in order to effectively reduce stressors at work[11,17,21,24].

While most studies with a focus on leadership training or coaching intervention reveal positive effects (e.g. regarding leaders' knowledge, attitudes or well-being), there are contradictory results regarding employees' health and well-being[25–32].

On the one hand, recent reviews conclude that leadership development programs can improve employees (e.g. mental health, well-being), organisational (e.g. work environment) or patient-related outcomes[29,32,33]. For example, a one-year leadership intervention with 42 senior nursing managers focusing on topics such as leaders' self-reflection, self-care, encouraging a sharing and supporting work culture, effectively managing negative emotions, identifying stressors and risks at work and enhancing work-life balance showed significantly positive effect on leaders and overall workplace wellbeing[30]. On the other hand, a 3-month intervention program on work-related stress (identify sources of stress and associations with mental and physical illness, improve managers' skills for helping employees deal with stressful working conditions) for 41 health professional leaders showed no significant effect on employee well-being, sickness absence and work characteristics[31]. Also, no significant pooled effect was found on employees' psychological symptoms regarding the training of workplace managers[26].

However, studies using interventions among leaders are rare, difficult to conduct (e.g. due to different leadership styles, modelling of anticipated effects, strong intervention needed, evaluation), cost-intensive, and the targeted group (employees) of the intervention is indirect[20]. Nevertheless, several studies recommend that leaders be chosen as the primary target group for effective interventions reducing work-related stress within the organisation[20,33,34], especially using interactive workshops, multi-source or 360-degree feedback, coaching and mentoring[35]. However, studies with a focus on interventions to reduce work-related stressors, sufficient data on the employee level regarding the effect of leadership training programs as well as including various healthcare settings and professions, are currently lacking[18,26].

Therefore, the aim of this study is to investigate whether the STRAIN intervention program (using an evidence-based training program for health professional leaders working in upper-, middle and lower management levels) can reduce work-related stress among health professionals working in hospitals, nursing homes and home care organisations. The following research question was developed for this purpose: 'Does an evidence-based training intervention for health professional leaders significantly reduce work-related stress (e.g. the effort-reward imbalance) among health professionals working in hospitals, nursing homes and home care organisations compared to those not receiving any leadership intervention?'. This study is designed to assess the hypothesis that an evidence-based training program for leaders will have a significant positive effect on health professional's effort-reward (im)-balance, significantly reduce quantitative demands at work, difficulties with demarcation as well as work-private life conflicts, and enhance opportunities for development, their bond with the organisation, their perceived quality of leadership, social community at work, role clarity as well as perceived rewards.

Methods

Design

This study is called 'work-related stress among health professionals in Switzerland (STRAIN)' and is based on a cluster randomised controlled trial (Clinical Trials registration: NCT03508596, date of first trial registration: 26/04/2018) conducted in Swiss acute care, rehabilitation and psychiatric hospitals, nursing homes and home care organisations. The study consists of a baseline measurement (T0), a first measurement before the intervention (T1) and a second measurement after the intervention programme (T2). The study was conducted between January 2017 and June 2021. The baseline measurement (T0) took place between September 2017 and March 2018, the first measurement (T1) between January 2019 and April 2019 and the second measurement (T2) between March and September 2020. This study design is based on three arms: (1) the intervention group (IG); (2) the control group (CG); and (3) the non-intervention group (NOIG) (see Fig. 1).

Questionnaire

For this study, the STRAIN questionnaire was used (see Supplement A and also[36,37]). The STRAIN questionnaire is based on the model of 'causes and consequences of work-related stress' from Eurofound[13] and includes various scales assessing stressors at work (e.g. quantitative demands, opportunities for development), stress reactions (e.g. behavioural stress reactions) and long-term consequences (e.g. effort–reward imbalance, burnout-symptoms, quality of sleep). The STRAIN questionnaire includes well-established, validated and reliable scales from the Copenhagen Psychosocial Questionnaire (COPSOQ)[37–39], the questionnaire used in the 'Nurses Early Exit Study' (NEXT)[40], the Sixth European Working Conditions Survey – EWCS[41], the effort-reward imbalance questionnaire[42], the self-rated general health status using EQ-5D-5L[43], the Work-Ability Index (WAI)[44] and the Inability due to Spine Complaints from Von Korff et al.[45]. For more detailed information regarding the questionnaire see Supplement A.
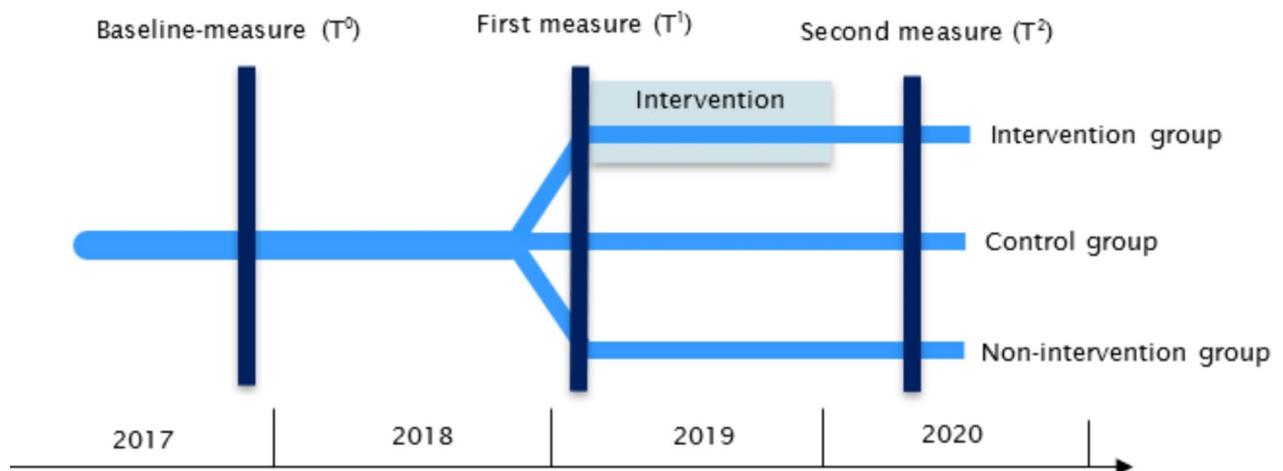
Fig. 1. STRAIN study design.

As the last data collection (T^2) was carried out during the COVID pandemic, an additional question regarding the extent to which the participating organisations were affected by COVID was added (not strong at all, less strong, moderate, strong, very strong). However, this question was not integrated into the STRAIN questionnaire, but was sent once to the contact person of the respective organisation.

In addition, an additional paper questionnaire regarding positive and negative impressions of the training programme was handed out to the leaders participating in the intervention programme after each training day, and could optionally be completed and returned immediately.

Primary and secondary outcome

As a primary outcome to evaluate the effect of the STRAIN intervention, the effort–reward imbalance questionnaire (effort–reward ratio[42] was used. As secondary outcomes, various stressors at work are used (scales from the COPSOQ[37,46]):

- Scale on quantitative demands (e.g. work at a high pace, doing overtime).
- Scale on opportunities for development (e.g. opportunity to develop skills).
- Scale on bond with the organisation (e.g. being proud to belong to this organisation).
- Scale on quality of leadership (e.g. superior is good at work planning, solving conflicts).
- Scale on social community at work (e.g. atmosphere, co-operation).
- Scale on role clarity (e.g. clear work tasks, objectives, area of responsibility).
- Scale on rewards (e.g. work is recognised and appreciated by the superior).
- Scale on difficulties with demarcation (e.g. being available in leisure time for work issues).
- Scale on work–private life conflict (e.g. conflict between work and private life).

Power estimation

Since there was no previous intervention study available using the effort–reward imbalance questionnaire as an outcome variable, we used previous literature regarding power calculation for randomised controlled trials[47] to estimate the needed power for this study. They recommend a total simple size of 1000 participants (20 clusters) to ensure a power > 0.8 to detect a moderate effect size of 0.3 (SD 1) at a significance level of 5%. For this reason, we aimed for a minimum number of participants for the study of 1000 employees per setting (acute care/rehabilitation hospitals, psychiatric hospitals, nursing homes, home care organisations).

Recruitment of healthcare organisations

Hospitals (acute care, rehabilitation, psychiatric), nursing homes and home care organisations were randomly selected from all registered organisations by the Swiss Federal Statistical Office in 2016. Excluded were organisations with a small size (average number of beds < 20 or fewer than 7 employees) or that were specialised (e.g. in gynaecology or neonatology only). By using a computer-based randomisation (randomizer.org) a total of 100 hospitals, 100 nursing homes and 100 home care organisations were invited to participate in the study, considering a geographically representative sample for Switzerland (69% German-speaking, 23% French-speaking, 8% Italian-speaking). During recruitment, the Chief Executive Officer (CEO) or the head of Human Resources was contacted directly by email and provided with information about the study (flyer and a short film). If we did not receive a response, they were contacted by phone in a further step. Finally, a total of 38 acute care, rehabilitation or psychiatric hospitals (25 German-speaking, 12 French-speaking, 1 Italian-speaking), 86 nursing homes (56 German-speaking, 24 French-speaking, 6 Italian-speaking) and 41 home care organisations (36 German-speaking, 3 French-speaking, 2 Italian-speaking) took part in the study.

Data collection

Data were collected using two online versions of the questionnaire (Umfrage Online® and Surveymonkey®) and a paper version (including a reply envelope). The questionnaire was available in German, French and Italian. Participating organisations were free to choose the time that suited them best during the data collection period T^0, T^1 and T^2. This was particularly relevant for the T^2 measurement due to the COVID pandemic, as the organisations were able to choose when they could participate between March and September. For data collection, a contact person for each organisation was involved in the distribution of the questionnaire and ensured that the questionnaire was available (via email, intranet or paper version). Nurses, midwives, physicians, medical-technical professionals, medical-therapeutic professionals, and employees from the administration and research at all hierarchical and skill levels (e.g. health professionals in training) working within the organisation were invited to participate in the study. Participants had one month to complete the questionnaire and received a reminder after the first two weeks. The proportion of repeated participation across the three measurements was low. Less than 10% of the participating health professionals took part in both T^1 and T^2 and less than 5% in all three measurement time points.

Ranking of organisations and allocation

To randomly assign participating health organisations into the three arms (IG, CG, NOIG), a ranking of work-related stress was conducted using the results from the baseline measure (T^0). Therefore, the mean values of the COPSOQ dimensions demands at work, work organisation and content, social relations and leadership and home–work interface were used for the ranking (see Supplement A for dimensions). Organisations with the highest extent of stressors at work were ranked top down. This was conducted separately for (1) acute care hospitals/rehabilitation hospitals, (2) psychiatric hospitals, (3) nursing homes and (4) home care organisations. Considering the participation rate of employees for each organisation, a minimum of 1500 participants was targeted to achieve the needed sample size separately for acute care / rehabilitation hospitals, psychiatric hospitals, nursing homes and home care organisations. In this process, the organisations were randomly assigned (top down – starting with organisations with the highest extent of stressors) into the intervention and control groups until the 1500 participants were reached using computer-based randomisation (randomizer.org). The person who performed the randomised allocation was blinded and not a member of the research team of this study. All remaining organisations (with a lower extent of work stressors) were assigned to the non-intervention group. This has the advantage that the intervention is mainly applied to those organisations with a higher extent of stressors and, therefore, are in a higher need for strategies to reduce work-related stress.

Figure 2 shows the organisations in- and excluded during the steps of enrolment, allocation, follow-up and analysis.

Despite randomisation, a group comparison between IG and CG of the T^0 baseline measurement was carried out (using Mann–Whitney U-test, Bonferroni corrected) for the primary and secondary outcomes and participants' sex. Significant differences between the IG and CG were found in acute care / rehabilitation hospitals for quantitative demands ($p < 0.00$), opportunities for development ($p < 0.001$), bond with the organisation ($p < 0.01$) and role clarity ($p < 0.01$). Significant differences between the IG and CG in psychiatric hospitals were found for the scale on bond with the organisation ($p < 0.05$) and for nursing homes for the scale on difficulties with demarcation ($p < 0.05$). Regarding home care organisations, significant differences between the IG and CG were found for opportunities for development ($p < 0.001$), quality of leadership ($p < 0.01$), rewards ($p < 0.001$), difficulties with demarcation ($p < 0.01$), the effort–reward ratio ($p < 0.001$) and participants' sex ($p < 0.05$).

Development of the STRAIN intervention

The intervention programme was developed specifically for healthcare leaders at all hierarchical levels, as they have an essential role in implementing effective measures for a healthy work environment[21,22,48]. The programme was developed as evidence-based in accordance with the intervention mapping (IM) approach[49]. The approach is suitable for designing and developing complex workplace interventions and programmes for different settings and stakeholders as it describes the path from problem identification to problem solving or reduction. The intervention mapping approach consists of six steps and leads towards evidence-based programme development, implementation and evaluation[49]. Step 1 focuses on the problem and consists of a needs assessment; steps 2, 3 and 4 involve the initial development of the intervention programme; Step 5 consists of the implementation planning; and Step 6 involves evaluation and refinement of the programme (Fig. 3). Following those steps helps to addresses questions about how and when to use theory, empirical findings from the literature and data collected from a population. Its purpose is to create an intervention that leads to an effective behaviour or system change[49].

A planning group of 10 people was installed and several workshops were held to develop the intervention programme. The planning group consisted of various researchers and health professionals (nurses, physiotherapists, physicians, occupational psychologists) from the German-, French- and Italian-speaking parts of Switzerland, most with a professional background in different work areas in the Swiss healthcare system and/or in a leadership position.

To develop an evidence-based intervention programme, various data sources were used in order to identify salient topics and contents (see Fig. 4). From the STRAIN baseline data set with 8,112 participating health professionals, several regression models were calculated for individual health disciplines, settings and outcomes[11]. The aim was to identify topics in which leaders have the greatest potential for reducing work stressors. In addition to these quantitative data, a total of 25 focus group interviews with various health professionals working in different settings of the Swiss healthcare sector were conducted to collect their ideas and recommendations on how to improve their working environment and reduce stressors at work[50]. Additionally, an extensive literature
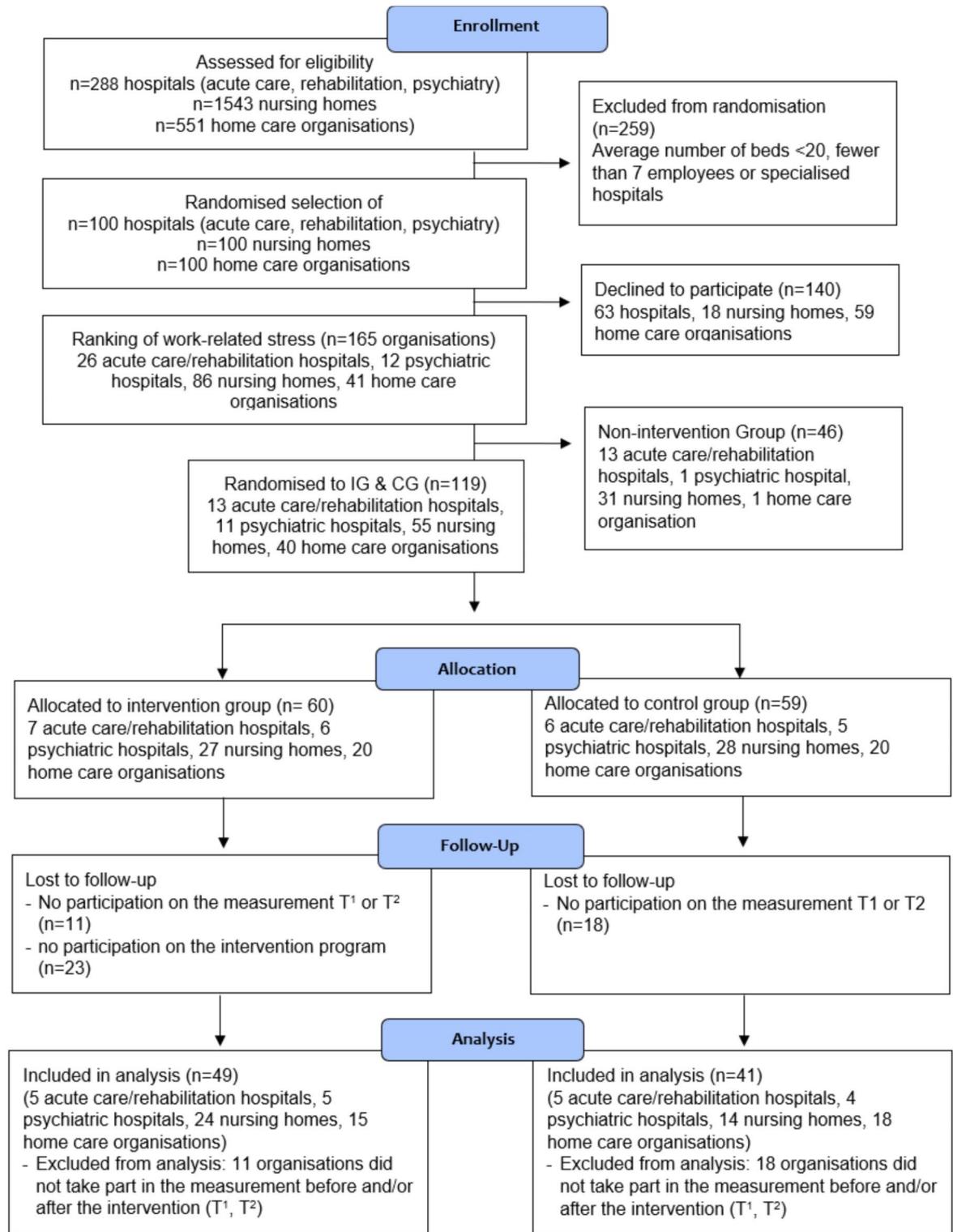
Fig. 2. CONSORT flow diagram of the STRAIN study.

research was conducted in order to identify published international literature on effective prevention and intervention strategies to reduce stress at work. Therefore, 1400 studies (reviews, meta-analyses, intervention studies) and available guidelines were summarised and analysed as to their recommendations. Those three data sources (quantitative, qualitative, literature) served in developing the study intervention that focuses on the health professional leaders working in the lower-, middle- and upper-management levels.

The intervention was standardised and structured in two days of training and a half a day of coaching. For the content of the programme, the following key topics were identified:
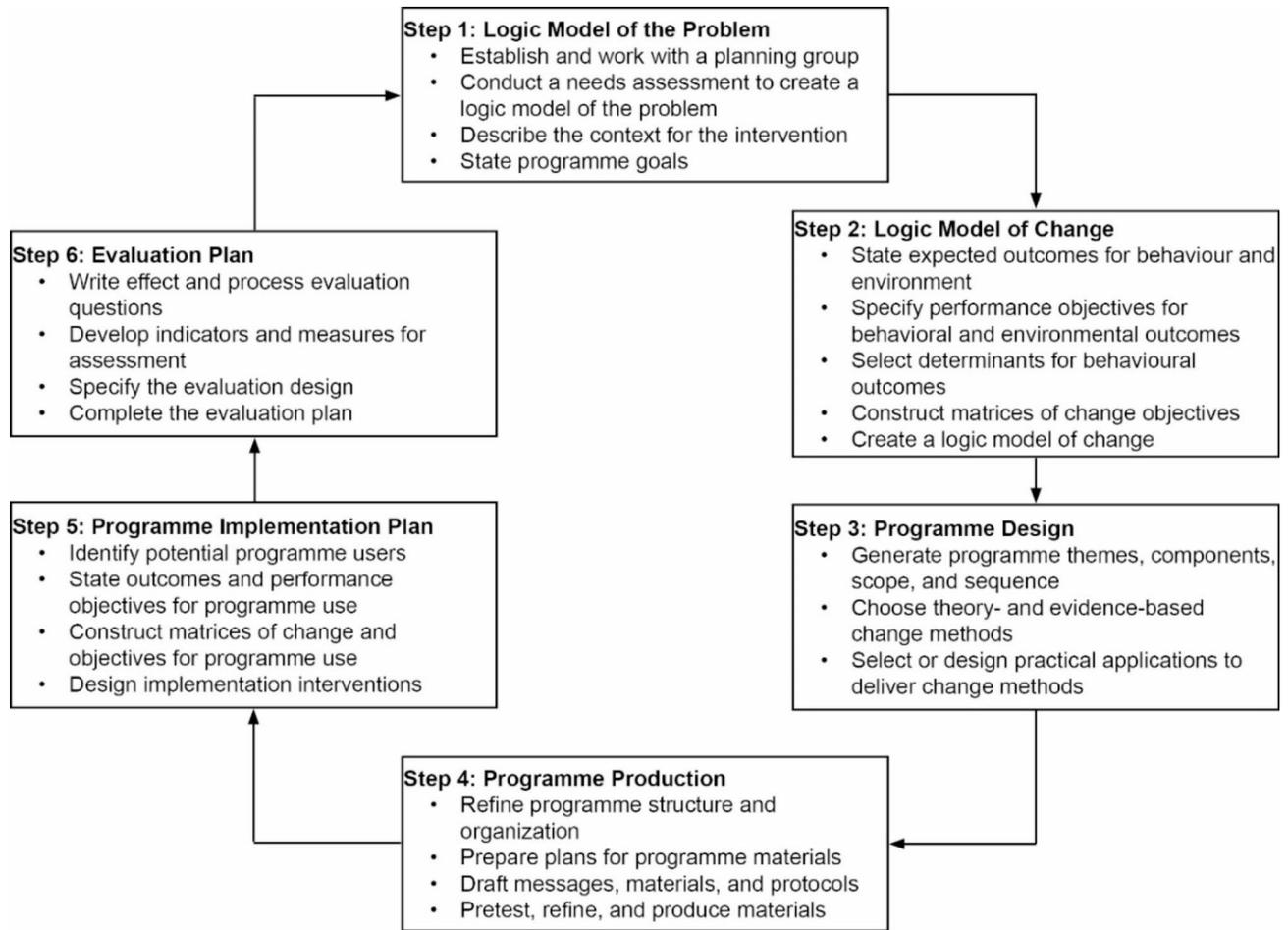
Step 1: Logic Model of the Problem
- Establish and work with a planning group
- Conduct a needs assessment to create a logic model of the problem
- Describe the context for the intervention
- State programme goals

Step 6: Evaluation Plan
- Write effect and process evaluation questions
- Develop indicators and measures for assessment
- Specify the evaluation design
- Complete the evaluation plan

Step 2: Logic Model of Change
- State expected outcomes for behaviour and environment
- Specify performance objectives for behavioral and environmental outcomes
- Select determinants for behavioural outcomes
- Construct matrices of change objectives
- Create a logic model of change

Step 5: Programme Implementation Plan
- Identify potential programme users
- State outcomes and performance objectives for programme use
- Construct matrices of change and objectives for programme use
- Design implementation interventions

Step 3: Programme Design
- Generate programme themes, components, scope, and sequence
- Choose theory- and evidence-based change methods
- Select or design practical applications to deliver change methods

Step 4: Programme Production
- Refine programme structure and organization
- Prepare plans for programme materials
- Draft messages, materials, and protocols
- Pretest, refine, and produce materials

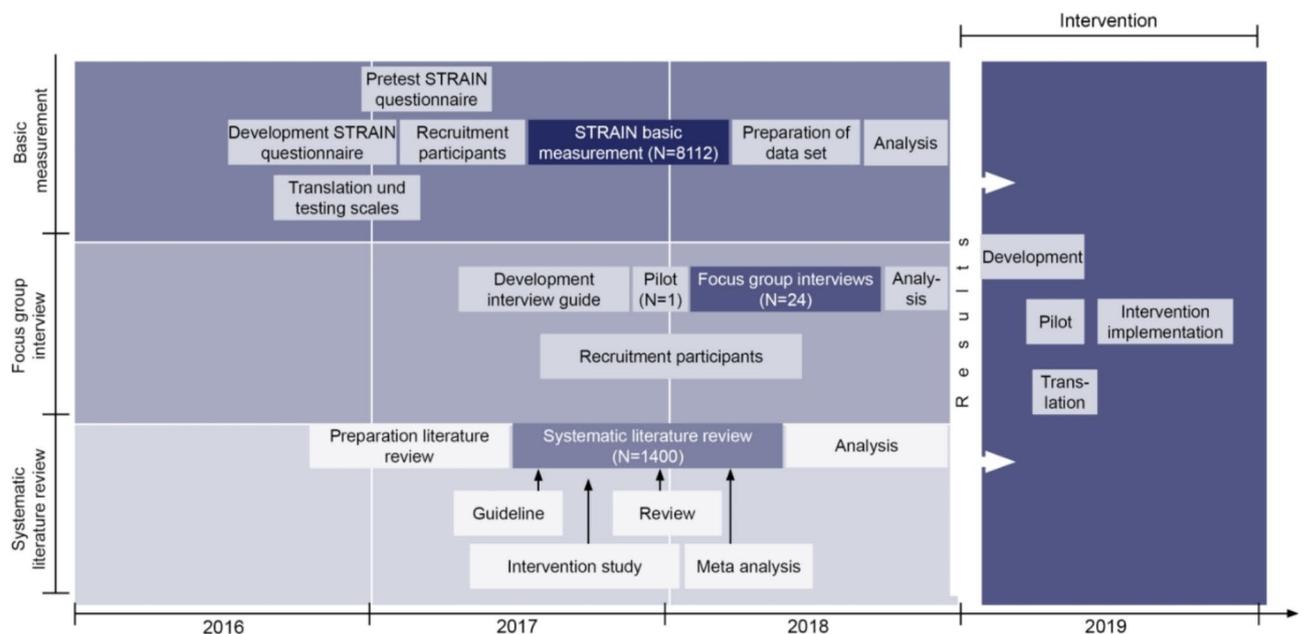**Fig. 3**. Six steps of the intervention mapping approach (Bartholomew Eldredge et al., 2016)[37].

Fig. 4. Data sources used to develop the STRAIN intervention programme.

(1) Reducing stressors in the upper-, middle- and lower-management levels,
(2) Enhance the compatibility of work and private life,
(3) Match requirements at work with skills and resources,
(4) Optimise leadership understanding and structures,
(5) Strengthen organisational commitment (reward, feedback, opportunities for development and salary),
(6) Create clear role profiles and competency-based deployment; and.
(7) Promote intra- and interprofessional communication and collaboration.

The key topics (1–3) were addressed on day 1 and the key topics (4–7) on day 2. The sequences for the individual key topics were developed individually based on the defined determinants, the corresponding objectives and methods (according to the intervention mapping approach[49]). At the beginning of the sequence, we often used methods to increase the 'awareness and risk perception' (e.g. consciousness raising, framing or personalised risk – using organisation-specific results from the baseline measure e.g. regarding the results of non-compliance with break and rest times within the organisation) to raise the awareness among leaders as to why the topic is important and what benefits a positive change could have. In addition, we used various methods to change attitudes, beliefs and outcome expectations (e.g. environmental re-evaluation, shifting perspective, cultural similarity), methods to change social influence (e.g. mobilising social support), methods to change skills, capability, self-efficacy and to overcome barriers (e.g. self-monitoring of behaviour, reattribution training, goal setting, planning copings responses) and to change environmental conditions, social norms and organisation (e.g. addressing team building and human relations training, enhancing network linkages, resistance to social pressure).

The intervention programme was developed in German and translated into French and Italian. The whole programme was primarily tested in one acute care hospital of the non-intervention group of the study (pilot).

STRAIN intervention programme

The study intervention included a two-day training programme and a 2–3-hour group-based coaching for health professional leaders (nurses, midwives, physicians, medical-technical and medical-therapeutic professionals) across organisations (e.g. leaders from different hospitals) and in multi-professional groups. The training programme included short presentations, group works and individual in-depth work (e.g. based on their own organisation-specific results from the baseline measure). In addition to presentations on current research results and measures to reduce workload, the face-to-face training sessions included many interactive parts to promote interprofessional and cross-organisational exchange between the leaders. This was followed by an additional 2–3 h of group coaching. During the intervention programme, health professional leaders were separated regarding their management level (upper- and middle-management levels in one group and lower-management level in another) to avoid the influence of organisational hierarchies in the intervention groups. The programme was also conducted for acute care / rehabilitation hospitals, psychiatric hospitals, nursing homes and home care organisations separately and took place between T^1 and T^2 (June 2019 until December 2019). The intervention programme was conducted in all language regions in Switzerland (German, French, Italian). After the programme, all leaders of the intervention group received an additional guideline including all the results / strategies to reduce stress at work presented in the intervention programme as a checklist (see Supplement B (German Version), Supplement C (French Version), Supplement D (Italian Version).

Data analysis

Data was analysed using SPSS 25® and R. All Items from the COPSOQ, EWCS, NEXT and Von Korff were transformed to having a value range from 0 (minimum value) to 100 points (maximum value), according to the original authors[46,51]. If fewer than half of the questions in a scale had been answered, no average score was calculated[51]. Further, the index for WAI (index scores from 7 to 49) and the effort–reward imbalance ratio (imbalance of high effort and low reward if effort–reward ratio > 1) were calculated according the original authors' method[42,44].

To test for significant differences between the IG and CG, an analysis of covariance (ANCOVA) using as outcomes the scales on effort-reward imbalance, quantitative demands, opportunities for development, bond with the organisation, quality of leadership, social community at work, role clarity, perceived rewards, difficulties with demarcation, work–private life conflict and intention to leave the profession at T^2, and as predictors the same scales at T^1 and a dummy variable for the treatment group assignment. This ANCOVA essentially models the (inflation-adjusted) difference of the outcomes between T^1 and T^2 and notably allows the extraction of the amount of the outcome increase from T^1 to T^2, which is more pronounced for the treatment group (time-by-group interaction). For analyses on the individual level of participants, we included random effects for the organisations and included only participants who participated at T^1 and T^2.

The analysis was carried out in two steps. In step one, the treatment effect was estimated, including all participating healthcare organisations on both the aggregated level of organisations and the individual level of participants. For this overall comparison of the IG and CG, an Intention-to-treat (ITT) as well as an As-treated (AT) analysis was conducted since in 23 (out of 60) organisations of the IG, no health professional leader took part in the intervention programme. In step two, treatment effects were analysed separately for acute care/rehabilitation hospitals, psychiatric hospitals, nursing homes and home care organisations. Since only a small amount of the respondents participated in both T^1 and T^2 (< 10%), models on the individual level could not be reliably estimated. Therefore, for simplicity, we performed the data analysis in step two on the aggregated level of organisation and using as-treated analysis only.

In a further step, more in-depth pre-/post-test analyses for each organisation were conducted separately, also regarding various stressors, stress symptoms and long-term consequences and considering the response rate of leaders in the intervention programme of each management level, the number of participants per organisation

as well as how they were affected by COVID during the second measurement. Therefore, a Bonferroni-corrected Mann–Whitney U-test was used.

In addition, the additional questionnaire (positive and negative impressions of the intervention programme) was descriptively analysed and the written statements were analysed to form categories and subcategories, which were then condensed thematically in a further step.

Results
Study sample description
A total of 19,340 health professionals participated in the study, 8,112 employees participated in the baseline measure, 6,438 in the first measure (before the intervention) and 4,790 in the second measure (after the intervention). Overall, 42.3% of the participants worked in acute care or rehabilitation hospitals, 23% in psychiatric hospitals, 20% in nursing homes and 14.7% in home care organisations. The majority of the sample consisted of women (83.2% women; 16.8% men), with 82.7% from the German-speaking, 15% from the French-speaking and 2.3% from the Italian-speaking region of Switzerland. Most participants (75.9%) were nurses (e.g. registered nurses or nurse assistants). The remaining part of the sample consisted of 1.0% midwives, 3.1% medical-technical professions, 8.9% medical-therapeutic professions, 6.5% physicians, 2.6% employees from administration and research and 2% others (e.g. social workers). Most participants (83.9%) had no leadership position, 10.7% worked in a lower, 3.9% in a middle and 1.5% in a higher leadership position. Overall, a total of 36.3% of participants were in the intervention group, 41.8% in the control group and 21.9% in the non-intervention group. Further details on the sample of the intervention and control groups are shown in Table 1.

Descriptive results regarding stressors, stress reactions and long-term consequences
In addition, descriptive results (mean values and standard deviation) for various stressors, stress reactions and long-term consequences among health professionals working in acute care / rehabilitation and psychiatric hospitals, nursing homes and home care organisations are presented in Supplement E for registered nurses, nurse assistants, physicians, medical-therapeutic professionals, medical-technical professionals and midwives.

		Overall ($n = 19,340$)		Intervention group ($n = 7008$)		Control group ($n = 8079$)	
		n	%	n	%	n	%
Measurement	T0 = Baseline measure (2017/2018)	8112	41.9	3033	43.3	3417	42.3
	T1 = First measure (before intervention, 2019)	6438	33.3	2640	37.7	2604	32.2
	T2 = Second measure (after intervention, 2020)	4790	24.8	1335	19.0	2058	25.5
Setting	Acute care / rehabilitation hospitals	8179	42.3	1949	27.8	3096	38.3
	Psychiatric hospitals	4464	23.0	2700	38.5	1193	14.8
	Nursing homes	3860	20.0	1254	17.9	2058	25.5
	Home care organisations	2837	14.7	1105	15.8	1732	21.4
Sex	Women	15,816	83.2	5628	81.8	6685	84.1
	Men	3205	16.8	1252	18.2	1263	15.9
Language region	German-speaking	14,871	82.7	5286	79.7	5814	80.9
	French-speaking	2715	15.0	1256	18.9	1112	15.5
	Italian-speaking	406	2.3	90	1.4	262	3.6
Profession	Registered Nurses	8185	48.0	2886	46.7	3211	46.1
	Nurse Assistants with a formal education	3537	20.7	1196	19.3	1788	25.7
	Nurse Assistants without formal education	1228	7.2	458	7.4	620	8.9
	Midwives	170	1.0	46	0.7	53	0.8
	Medical-technical professionals	523	3.1	202	3.3	171	2.5
	Medical-therapeutical professionals	1509	8.9	616	10.0	469	6.7
	Physicians	1101	6.5	374	6.0	401	5.8
	Employees in administration and research	440	2.6	147	2.4	191	2.7
	Others: e.g. employees from social services	353	2.0	261	4.2	60	0.9
Leadership position	Upper-management level	280	1.5	97	1.5	104	1.4
	Middle-management level	706	3.9	277	4.2	269	3.6
	Lower-management level	1945	10.7	692	10.5	783	10.4
	Without management responsibilities	15,295	83.9	5529	83.8	6391	84.7

Table 1. Description of overall study sample, intervention and control group. N = number of cases, Overall = intervention group, control group, group without intervention.

Comparison of intervention and control group

Table 2 presents the results regarding the overall comparison of the intervention and control group on the individual level of participants (score per participant who took part in T^1 and T^2 working in the same organisation) and aggregated on the organizational level (overall score per organisation) using an intention-to-treat and as-treated analysis.

Results revealed no significant differences ($p > 0.05$, with and without Bonferroni correction) between the IG and CG regarding all primary and secondary outcomes, such as the scales on effort-reward imbalance, quantitative demands, opportunities for development, bond with the organisation, quality of leadership, social community, role clarity, rewards, difficulties with demarcation and work–private life conflict regarding the results on the individual level of participants as well as on the organisational level using the intention-to-treat and as-treated analysis.

Further results regarding the comparison of the intervention and control group on the organisational level in different areas of work (as-treated analysis) are presented in Table 3. Also, no significant difference between the IG and CG was found for all primary and secondary outcome variables, such as the scales on effort-reward imbalance, quantitative demands, opportunities for development, bond with the organisation, quality of leadership, social community, role clarity, rewards, difficulties with demarcation and work–private life conflict among acute care/rehabilitation hospitals, psychiatric hospitals, nursing homes and home care organisations ($p > 0.05$).

Results for pre-/post-test analyses for each organisation of the intervention group

Table 4 shows the results before (T1) and after the intervention (T2) for each organisation of the IG and reveals further details regarding leaders' participation in the intervention programme (0–78% participation rate) and how severely the participating organisations were affected by the COVID pandemic (not strong at all = 1, less strong = 2, moderate = 3, strong = 4, very strong = 5). Table 4 also reveals that 11 organisations took part in the baseline measurement (T^0) and participated in the intervention programme, but did not take part in the measurement before and/or after the intervention (T^1, T^2). Further results regarding the pre-/post-test analysis revealed a tendency for significant positive results (overall effect after intervention, $p < 0.05$) regarding stressors, stress symptoms and long-term consequences for organisations with a high participation rate of leaders (75–78%) from the lower-, middle- and upper-management levels. However, no tendency for organisations with a participation rate of leaders of between 6% and 61% was found (results could be positive, negative or not significant). In 23 (out of 60) organisations of the intervention group, no leader took part in the intervention

Intention-to-treat analysis: Coefficients based on individual level of participants, mixed-effect ANCOVA model						As-treated analysis: Coefficients based on individual level of participants, mixed-effect ANCOVA model				
	B	β	SD	F	p	B	β	SD	F	p
Effort–reward imbalance score	-0.04	-0.06	0.04	1.18	0.281	0.00	0.00	0.04	0.00	0.969
Quantitative demands	0.82	0.02	1.31	0.39	0.536	-1.43	-0.04	1.40	1.05	0.313
Opportunities for development	0.04	0.00	0.95	0.00	0.964	-0.17	-0.01	1.00	0.03	0.866
Bond with the organisation	-1.82	-0.04	1.60	1.30	0.259	-1.20	-0.03	1.68	0.52	0.476
Quality of leadership	-2.82	-0.07	1.94	2.12	0.153	-2.02	-0.04	2.03	0.99	0.326
Social community	0.30	0.01	1.39	0.05	0.829	-0.76	-0.03	1.46	0.27	0.606
Role clarity	-2.17	-0.07	1.16	3.48	0.069	-1.22	-0.04	1.22	1.00	0.324
Rewards	-0.80	-0.02	2.68	0.09	0.766	-0.97	-0.02	2.79	0.12	0.729
Difficulties with demarcation	1.96	0.04	1.43	1.86	0.181	1.77	0.04	1.49	1.41	0.244
Work–private life conflict	2.59	0.06	1.37	3.56	0.069	2.09	0.05	1.43	2.15	0.154

Intention-to-treat analysis: Coefficients based on organizational level						As-treated analysis: Coefficients based on organizational level					
	B	β	SD	F	*p*	partial η²	B	β	SD	F	*p*	partial η²
Quantitative demands	-0.03	-0.08	0.03	0.68	0.413	0.01	0.02	0.06	0.03	0.40	0.531	0.01
Opportunities for development	1.13	0.07	1.71	0.43	0.512	0.01	-0.89	-0.05	1.84	0.24	0.629	0.00
Bond with the organisation	-0.82	-0.07	1.35	0.37	0.544	0.00	-0.25	-0.02	1.45	0.03	0.865	0.00
Quality of leadership	-1.25	-0.07	1.54	0.66	0.419	0.01	-0.84	-0.04	1.67	0.25	0.618	0.00
Social community	-0.54	-0.03	1.85	0.09	0.770	0.00	0.24	0.01	1.98	0.01	0.903	0.00
Role clarity	-0.60	-0.04	1.36	0.20	0.660	0.00	0.76	0.05	1.44	0.28	0.600	0.00
Rewards	-2.23	-0.18	1.14	3.83	0.054	0.05	-0.68	-0.05	1.24	0.30	0.587	0.00
Difficulties with demarcation	1.24	0.04	2.26	0.30	0.586	0.00	2.13	0.07	2.43	0.77	0.382	0.01
Work–private life conflict	1.97	0.11	1.80	1.20	0.276	0.02	-0.22	-0.01	1.94	0.01	0.910	0.00

Table 2. Overall comparison of intervention and control group on individual and organizational level (intention-to-treat and as-treated analysis). Coefficients refer to the time-by-group interaction. B = unstandardized coefficients, β = standardized coefficients, SD = Sandard Deviation, F = F-statistic, p = p-value *p < 0.05, **p < 0.01, ***p < 0.001, partial η² = partial eta-squared.

Acute care / rehabilitation hospitals							Psychiatric hospitals						
	B	β	SD	F	p	partial η²		B	β	SD	F	p	partial η²
Effort–reward imbalance score	0.01	0.07	0.06	0.04	0.843	0.01	Effort–reward imbalance score	0.09	0.61	0.05	3.38	0.115	0.36
Quantitative demands	-0.50	-0.07	2.38	0.05	0.837	0.01	Quantitative demands	2.71	0.44	1.76	2.37	0.175	0.28
Opportunities for development	-1.17	-0.17	2.12	0.30	0.597	0.04	Opportunities for development	-3.37	-0.46	1.58	4.58	0.076	0.43
Bond with the organisation	-3.10	-0.26	3.18	0.95	0.358	0.11	Bond with the organisation	-7.47	-0.69	3.52	4.51	0.078	0.43
Quality of leadership	-4.56	-0.32	3.82	1.43	0.267	0.15	Quality of leadership	-5.43	-0.26	3.66	2.20	0.188	0.27
Social community	-2.42	-0.29	2.72	0.79	0.400	0.09	Social community	-2.89	-0.35	2.25	1.66	0.245	0.22
Role clarity	-2.36	-0.37	2.08	1.29	0.289	0.14	Role clarity	-9.21	-0.60	4.95	3.45	0.112	0.37
Rewards	-0.25	-0.01	4.44	0.00	0.956	0.00	Rewards	4.58	0.23	4.90	0.87	0.386	0.13
Difficulties with demarcation	-3.72	-0.23	5.40	0.47	0.511	0.06	Difficulties with demarcation	3.28	0.44	2.73	1.44	0.275	0.19
Work–private life conflict	0.51	0.05	2.12	0.06	0.815	0.01	Work–private life conflict	5.83	0.61	2.66	4.78	0.071	0.44
Nursing homes							Home care organisations						
	B	β	SD	F	p	partial η²		B	β	SD	F	p	partial η²
Effort–reward imbalance score	-0.05	-0.11	0.06	0.66	0.424	0.02	Effort–reward imbalance score	-0.01	-0.04	0.04	0.05	0.829	0.00
Quantitative demands	1.96	0.08	4.16	0.22	0.641	0.01	Quantitative demands	-3.14	-0.22	2.18	2.07	0.161	0.07
Opportunities for development	-0.34	-0.02	3.19	0.01	0.917	0.00	Opportunities for development	0.69	0.05	2.15	0.10	0.749	0.00
Bond with the organisation	3.25	0.13	4.34	0.56	0.460	0.02	Bond with the organisation	-1.16	-0.09	2.11	0.30	0.586	0.01
Quality of leadership	3.98	0.15	4.38	0.83	0.372	0.03	Quality of leadership	0.61	0.03	3.36	0.03	0.858	0.00
Social community	2.51	0.12	3.45	0.53	0.474	0.02	Social community	1.62	0.12	2.18	0.55	0.463	0.02
Role clarity	2.81	0.18	2.29	1.50	0.231	0.05	Role clarity	1.28	0.13	1.63	0.62	0.439	0.02
Rewards	4.24	0.14	5.08	0.70	0.411	0.03	Rewards	5.08	0.19	4.23	1.44	0.240	0.05
Difficulties with demarcation	-0.25	-0.01	4.23	0.00	0.954	0.00	Difficulties with demarcation	-0.16	-0.01	2.45	0.00	0.949	0.00
Work–private life conflict	4.15	0.17	3.40	1.49	0.232	0.05	Work–private life conflict	-1.20	-0.12	1.89	0.40	0.530	0.01

Table 3. Comparison of intervention and control group on organizational level regarding different areas of work (as-treated analysis). B = unstandardized coefficients, β = standardized coefficients, SD = Sandard Deviation, F = F-statistic, p = p-value $*p < 0.05$, $**p < 0.01$, $***p < 0.001$, partial η² = partial eta-squared.

programme. In 30% ($n = 11$) of the participating organisations in the intervention group more than 50% of leaders did take part in the intervention. In 70% ($n = 26$) of the organisations, the participation rate of leaders in the intervention programme was less than 50%.

Evaluation of the intervention programme

In total, 206 health professional leaders took part in the programme (151 from the lower- and 55 from the middle- and upper-management levels). Most participating leaders ($n = 142$ statements) stated that the exchange in the group work with managers from other healthcare organisations and professional groups was considered particularly beneficial. In addition, the content of the intervention programme ($n = 117$ statements), the multi-professional group composition ($n = 72$ statements), the teaching materials, in-depth literature and methods used ($n = 126$ statements) stood out positively in the evaluations. The need for optimisation was mentioned regarding organisational matters (i.e. breaks, rooms, $n = 93$ statements), fewer figures, but more examples in the teaching materials, $n = 78$ statements), additional professions (i.e. cleaning, transport service) to be allowed to participate in the intervention programme ($n = 33$ statements) and for multi-professional dialogue to be promoted more strongly ($n = 8$ statements).

Discussion

In this study, detailed results regarding the development and testing of an evidence-based, multilingual, cross-organisational and multi-professional intervention programme conducted in acute care/rehabilitation hospitals, psychiatric hospitals, nursing homes and home care organisations.

Overall, the results reveal no significant differences between the IG and CG for all primary and secondary outcomes and regarding acute care/rehabilitation hospitals, psychiatric hospitals, nursing homes and home care organisations separately using as-treated analysis. Therefore, our study's results did not confirm our initial hypothesis. Similar results were reported regarding the effect of overall organisational interventions with no apparent benefit, compared to more specific interventions, such as shorter or interrupted work schedules, in significantly reducing stress levels[19,26]. However, this could be due to the fact that the STRAIN intervention addresses several stressors and does not just focus on reducing one single stressor (e.g. work schedules)[19]. Also, previous studies suggest a multilevel and longitudinal approach using leadership development programs[33,35]. Although the STRAIN intervention program was based on workshops and feedback (e.g. reports from the baseline measurement), the program was limited to a two-day training programme and a 2–3-hour group-based coaching session. A repeated programme lasting several weeks, including several individual coaching sessions or mentoring, could possibly improve the outcome and benefits of the intervention program.

	Leaders' participation rate in intervention programme	Participation lower-management level	Participation middle-/upper-management level	Total number of cases	First measure number of cases	Second measure number of cases	Affected by covid	Stressors	Stress symptoms and long-term consequences	Overall effect after intervention
Home care organisation	78%	x	x	56	29	27	n/d	Influence at work improved ($p<0.05$, MWT1 = 50.0, MWT2 = 59.6)	Intention to leave the profession decreased ($p<0.05$, MWT1 = 14.6, MWT2 = 5.7)	Positive
Home care organisation	75%	x	x	22	9	6	moderate	No significant differences	Quality of sleep improved ($p<0.05$, MWT1 = 73.6, MWT2 = 86.9)	Positive
Home care organisation	61%	x	x	196	57	97	less strong	Decrease in role clarity at work ($p<0.05$, MWT1 = 84.7, MWT2 = 79.5), Problems with demarcation improved ($p>0.05$, MWT1 = 47.6, MWT2 = 43.4)	No significant differences	Positive & negative
Home care organisation	58%	x	x	113	n/d	n/d	n/d	n/d	n/d	n/d
Home care organisation	55%	x	x	150	40	61	strong	No significant differences	No significant differences	
Acute care / rehabilitation hospital	55%	x	x	170	50	40	n/d	No significant differences	No significant differences	
Home care organisation	54%	x	x	51	18	17	n/d	Quality of leadership decreased ($p<0.05$, MWT1 = 83, MWT2 = 75), Social community at work decreased ($p<0.001$, MWT1 = 97.2, MWT2 = 82), Predictability of work decreased ($p<0.05$, MWT1 = 82.6, MWT2 = 76.2)	Intention to leave the organisation improved ($p<0.05$, MWT1 = 5.5, MWT2 = 20), job satisfaction decreased (py0.05, MWT1 = 81, MWT2 = 70.8)	Negative
Psychiatric hospital	53%	x	x	857	336	188	strong	Demands to hide emotions worsened ($p<0.05$, MWT1 = 41.2, MWT2 = 46.2) Scope for breaks/holidays decreased ($p<0.01$, MWT1 = 68.2, MWT2 = 63.2), Bond with the organisation decreased ($p<0.01$, MWT1 = 58.0, MWT2 = 51.8), Perceived rewards at work decreased ($p<0.05$, MWT1 = 56.9, MWT2 = 51.5)	Behavioural stress symptoms increased ($p<0.05$, MWT1 = 30.9, MWT2 = 35.8), Cognitive stress symptoms increased ($p<0.05$, MWT1 = 25.5, MWT2 = 29.2), Burnout symptoms increased ($p<0.05$, MWT1 = 40.1, MWT2 = 44.7), Intention to leave the organisation ($p<0.01$, MWT1 = 23.6, MWT2 = 31.6) and the profession ($p<0.05$, MWT1 = 16.3, MWT2 = 20.7) increased	Negative
Home care organisation	50%	x	x	23	n/d	n/d	n/d	n/d	n/d	n/d
Nursing home	50%	x	x	90	37	16	n/d	Demands to hide emotion decreased ($p<0.05$, MWT1 = 35.5, MWT2 = 23.4), Possibilities for development improved ($p<0.05$, MWT1 = 69.1, MWT2 = 79.2), Perceived feedback improved ($p<0.05$, MWT1 = 62.5, MWT2 = 85.9), Quality of leadership improved ($p<0.05$, MWT1 = 66.5, MWT2 = 86.7), Social community at work improved ($p<0.05$, MWT1 = 79.9, MWT2 = 91.4), Social support at work improved ($p>0.001$, MWT1 = 76.7. MWT2 = 93.4), Predictability of work improved ($p<0.01$, MWT1 = 66.3, MWT2 = 83.6), Work–private life conflicts decreased ($p<0.05$, T1 = 32.3, MWT2 = 13.4)	Cognitive stress symptoms decreased ($p<0.001$ MWT1 = 36.9, MWT2 = 13.7), General health status improved ($p<0.01$, MWT1 = 75.3, MWT2 = 89.3), Burnout symptoms decreased ($p<0.05$, MWT1 = 40.1, MWT2 = 24.5), Job satisfaction improved ($p<0.01$, MWT1 = 72.9, MWT2 = 83.1)	Positive
Home care organisation	50%		x	43	n/d	n/d	Not strong at all	n/d	n/d	n/d
Psychiatric hospital	43%	x	x	333	n/d	n/d	n/d	n/d	n/d	n/d
Acute care / rehabilitation hospital	41%	x	x	143	n/d	n/d	n/d	n/d	n/d	n/d
Home care organisation	40%		x	22	n/d	n/d	Moderate	n/d	n/d	n/d

Continued

	Leaders' participation rate in intervention programme	Participation lower-manage-ment level	Participation middle-/upper-management level	Total number of cases	First measure number of cases	Second measure number of cases	Affected by covid	Stressors	Stress symptoms and long-term consequences	Overall effect after inter-vention
Home care organisation	40%	x	x	40	15	13	Not strong at all	Quantitative demands at work decreased ($p < 0.01$, MWT1 = 65, MWT2 = 54.8)	no significant differences	Positive
Acute care / rehabilitation hospital	35%	x	x	383	158	115	n/d	Demands to hide emotions increased ($p < 0.05$, MWT1 = 40.3, MWT2 = 47.7), Quality of leadership decreased ($p < 0.05$, MWT1 = 59.2, MWT1 = 53.3), Difficulties with demarcation increased ($p < 0.01$, MWT1 = 28.5, MWT2 = 37.9)	Behavioural stress symptoms increased ($p < 0.05$, MWT1 = 36.7, MWT2 = 40.2), Burnout-symptoms increased ($p < 0.01$, MWT1 = 51.3, MWT2 = 59.6), Job satisfaction decreased ($p < 0.01$, MWT1 = 65.8, MWT2 = 59.8)	Negative
Nursing home	33%	x	x	31	9	11	Moderate	Demands to hide emotions decreased ($p < 0.05$, MWT1 = 48.4, MWT2 = 35), Possibilities for development decreased ($p < 0.05$, MWT1 = 74, MWT2 = 61.4), Social relations at work decreased ($p < 0.05$, MWT1 = 80.5, MWT2 = 62.5)	No significant differences	pos/neg
Home care organisation	33%		x	31	10	9	n/d	No significant differences	No significant differences	
Home care organisation	29%		x	67	22	18	n/d	No significant differences	No significant differences	
Nursing home	27%	x	x	122	45	26	n/d	Bond with the organisation decreased $p < 0.001$, MWT1 = 74, MWT2 = 51.2)	Job satisfaction decreased ($p < 0.05$, MWT1 = 68.7, MWT2 = 55.2)	Negative
Home care organisation	25%		x	64	13	17	Moderate	No significant differences	No significant differences	
Home care organisation	25%		x	18	8	6	Not strong at all	No significant differences	No significant differences	
Home care organisation	25%		x	35	11	14	Not strong at all	No significant differences	No significant differences	
Acute care / rehabilitation hospital	25%	x	x	1041	n/d	n/d	n/d	n/d	n/d	n/d
Psychiatric hospital	24%	x	x	456	96	99	Moderate	Emotional demands increased ($p < 0.05$, MWT1 = 57.9, MWT2 = 62.2), Work–private life conflicts increased ($p < 0.05$, MWT1 = 26.4, MWT2 = 36.3)	Behavioural stress symptoms increased ($p < 0.01$, MWT1 = 31.3, MWT2 = 40.9), Burnout symptoms increased ($p < 0.05$, MWT1 = 40.0, MWT2 = 48.3)	Negative

Continued

	Leaders' participation rate in intervention programme	Participation lower-management level	Participation middle-/upper-management level	Total number of cases	First measure number of cases	Second measure number of cases	Affected by covid	Stressors	Stress symptoms and long-term consequences	Overall effect after intervention
Psychiatric hospital	23%	x	x	466	146	86	Very strong	Demands to hide emotions decreased ($p < 0.05$, MWT1 = 46.9, MWT2 = 40.86), Possibilities for development increased ($p < 0.05$, MWT1 = 65.8, MWT2 = 70.9), Role clarity improved ($p < 0.05$, MWT1 = 70.9, MWT2 = 75), Feeling of unfair behaviour decreased ($p < 0.05$, MWT1 = 14.7, MWT2 = 7.0), Social support at work improved ($p < 0.05$, MWT1 = 73.1, MWT2 = 80.4) Insecurity of working conditions decreased ($p < 0.01$, MWT1 = 35.9, MWT2 = 23.7)	No significant differences	Positive
Nursing home	22%	x	x	25	n/d	n/d	Not strong at all	n/d	n/d	n/d
Nursing home	22%	x		19	n/d	n/d	Very strong	n/d	n/d	n/d
Acute care / rehabilitation hospital	20%	x	x	79	29	23	Not strong at all	Quantitative demands at work increased ($p < 0.05$, MWT1 = 52.7, MWT2 = 61.4), Scope for breaks / holidays increased ($p < 0.05$, MWT1 = 61.6, MWT2 = 69.3),	General health status improved ($p < 0.05$, MWT1 = 57.4, MWT2 = 74.6)	Positive & negative
Home care organisation	20%		x	26	n/d	n/d	n/d	n/d	n/d	n/d
Psychiatric hospital	18%	x	x	61	20	18	n/d	No significant differences	No significant differences	n/s
Nursing home	13%	x	x	141	54	46	Less strong	No significant differences	No significant differences	
Acute care / rehabilitation hospital	12%	x		51	22	12	n/d	No significant differences	No significant differences	
Nursing home	11%	x		93	29	15	Very strong	No significant differences	No significant differences	
Acute care / rehabilitation hospital	10%	x		82	23	34	Very strong	No significant differences	No significant differences	
Nursing home	10%	x		50	n/d	n/d	n/d	n/d	n/d	n/d
Nursing home	6%		x	214	69	60	Very strong	Quantitative demands at work increased ($p < 0.05$, MWT1 = 45.1, MWT1 = 52.1), Social community at work improved ($p < 0.05$, MWT1 = 75, MWT2 = 80.7), Difficulties with demarcation increased ($p < 0.05$, MWT1 = 29.3, MWT2 = 37.5)	No significant differences	Positive & negative

Table 4. Results for each organisation of the intervention group (pre/post – before and after the intervention). Organisations of the intervention group with a leaders participation rate of 0% = 1 Psychiatric hospital, 18 nursing homes, 4 home care organisations, n/d = no data.

In addition, the ranking of organisations to participate in the IG and CG according to the highest extent of stressors at work had the benefit of addressing organisations with a higher need for interventions to reduce stress at work. However, there is a reason why these organisations showed the highest level of stress in the baseline measurement, and working with them was challenging at times (e.g. due to lack of participation in the intervention programme and data collections, addressing resistance in the training programme, readiness for change and leadership skills). While some organisations from the non-intervention group (with a lower extent of work stressors) were asking and willing to participate in the STRAIN intervention, but were not included due to methodology reasons. However, organisational commitment and readiness is a crucial prerequisite for successful change[52] and leaders in all hierarchical levels play an important role regarding their individual readiness, commitment, leadership skills and self-efficacy[17,52,53]. Therefore, a focus on managers / organisations that demonstrate a willingness / readiness to change could have been more beneficial for the implementation of the STRAIN intervention.

Furthermore, an important topic was also the commitment and participation in the measurements and in the STRAIN intervention programme. In 38% of the organisations in the IG, no manager took part in the intervention programme and in 18% of the organisations in the intervention group no sufficient data were collected to analyse the intervention. If health professional leaders did participate in the intervention programme, in 70% of the organisations the participation rate of leaders was less than 50%. Results of a previous study reveal that although two-thirds of leaders are aware that work-related stress is a problem and that measures should be taken to reduce it, only one-third of those leaders actually take action to reduce work-related stress[54]. Health professional leaders play an important role regarding the assessment of stress levels and their significant commitment and prioritisation is key in order to implement effective strategies to reduce work-related stress within the organisation[17,20,21,54]. This is also supported by our results, regarding the pre-/post-test analysis and the tendency for significant positive results (overall effect after the STRAIN intervention, $p < 0.05$) for stressors, stress symptoms and long-term consequences among organisations with a high participation rate (75–78%) of leaders.

Strengths and limitations

This study is one of the largest multilingual intervention studies in the Swiss healthcare system, which includes various healthcare professions as well as different areas of work. The successful co-operation between the three language regions (German, French, Italian) in the development, implementation and testing of the intervention programme is a further strength of this study. For the development of the STRAIN intervention, an already widely used approach (intervention mapping) was used, which provides an optimal structure, important methodological background and tips for implementation and requires evidence-based development of the content. This is essential to ensuring that the intervention addresses those stressors where change is most needed.

However, participation in the study was voluntary, which is why we were dependent on a strong commitment and willingness to participate for the repeated data collection and participation in the intervention. The covid pandemic has also affected the six-month implementation phase (time between training and T^2) and the measurement after the intervention (T^2). This led to several limitations in the study. Since less than 10% of the health professionals participated in the data measurements before and after the intervention, the analysis for the different work areas had to be calculated and aggregated at the organisational level (average value per organisation before and after the intervention) instead of at the participant level. Also, nurses dominated the study sample in nursing homes and home care organisations, while in acute care, rehabilitation, and psychiatric hospitals a greater variation of health professions was represented (regarding the average value per organisation). It is also unclear how strongly the COVID pandemic has influenced the willingness to implement the STRAIN measures from the intervention programme, and the willingness to participate in the measurement after the intervention (T^2), although the last measurement (T^2) assessed and reported on how severely the participating organisations were affected. This could have had a negative impact on the willingness to participate by health professionals and also on their self-reports with regard to stressors and consequences at work. In addition, it cannot be ruled out that a higher response rate in the measurement before and after the intervention and higher participation of leaders in the intervention programme could have led to significantly better results regarding the overall impact of the STRAIN intervention. However, a further limitation is the significant differences in primary and secondary outcomes between the IG and CG even before the intervention was carried out, despite the blinded and randomised allocation of the organisations to the two groups. In addition, although the training-based intervention programme was standardised and limited to the seven topics, each leader was able to decide which specific measures they considered useful and implemented, depending on the situation in their organisation. As a result, the intervention could only be evaluated in general terms, as it was not possible to track which measures the leaders actually implemented and how effectively.

Conclusions

Health professional leaders play an important role regarding their awareness, prioritisation, commitment and readiness for change when it comes to work-related stress and the implementation of effective strategies to reduce salient stressors. Therefore, it can be important for the success of an intervention to evaluate the level of leaders' awareness and risk perception of work-related stress as well as the readiness for change as a prerequisite for participation in an intervention programme. However, the ITT and AT analysis of this cluster randomised trial did not confirm that the STRAIN intervention program reduced work-related stress. Still, the STRAIN intervention may be effective when leader commitment is high. Furthermore, it can be beneficial to test measures individually (e.g. adjustment of working hours) rather than test a set of measures to reduce stress in order to identify their effective influence on health professionals' work-related stress. However, the individual adaptation of the measure to reduce salient stressors to the circumstances and current situation in the respective

organisation is crucial. This is where health professional leaders in all hierarchies are particularly challenged to optimally adapt standardised measures to the context of their organisation for implementation.

Data availability
The raw data set analysed in the current study is available from the corresponding author on reasonable request.

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Author contributions

KAP, CV, SK, TS, CG, AZ, AB, CG, AG, FR and SH designed the questionnaire and recruited the participating health organisations. KAP, CV, SK, TS, and FR collected and analysed the data. KAP, CV, SK, TS, AZ and AB developed and implemented the STRAIN intervention programme. SH supervised the whole study. KAP made substantial contributions to the interpretation of data and in writing the manuscript. All authors read and approved the final manuscript.

Declarations

Competing interests

The authors declare no competing interests.

Ethics approval and consent to participate

The responsible Swiss ethical board in Bern (Kantonale Ethikkommission Bern) confirmed that approval for the 'STRAIN' study is deemed unnecessary according to national legislation and does not fall under the Swiss Federal Act on Research Involving Human Beings (reference number: Req-2016-00616). The study was conducted in accordance with the Declaration of Helsinki. All health employees of the participating organisations were informed about the aim, procedures, risks, benefits, anonymity of data, and alternatives for participating in the study via online announcement / paper flyer and a short explanatory video so that they could make an informed decision about participation. Informed consent was obtained and participants were again informed on the first page of the questionnaire about the aim, procedure, and possible risks and had to actively give their consent (written, using a checkbox) to continue the questionnaire. The study was carried out on a voluntary basis for all participating organisations and health professionals; all participants were free to stop filling out the questionnaire at any time and had the opportunity to contact the research team via hotline if they had any questions. Data were anonymised and analysed only in units of analysis of at least 6 participants

(e.g. per occupational group or ward).

Additional information

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