The impact of the multicomponent "Healthy and Vital" 3-month lifestyle intervention in health professionals: a single group pre-(multiple) post-study

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The impact of the multicomponent "Healthy and Vital" 3-month lifestyle intervention in health professionals: a single group pre-(multiple) post-study

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Abstract

Background Working in healthcare often involves stressful situations and a high workload, and many healthcare workers experience burnout complaints or suffer from mental or physical problems. This also affects the overall quality of health care. Many previous workplace interventions focused on knowledge exchange instead of other health cognitions, and were not particularly effective. Multicomponent lifestyle interventions may offer the potential in improving lifestyle and well-being of healthcare professionals. This study aims to evaluate the impact of a multicomponent lifestyle intervention "Healthy and Vital" for healthcare professionals on several health-related outcomes.

Methods A pre- (multiple) post-pilot study has been conducted using data from 2012 to 2018 to evaluate the lifestyle intervention in 126 female healthcare professionals. Measurements were conducted before, directly after the intervention (at 3 months), and 6 months after finishing the intervention (at 9 months). Participants filled out questionnaires and anthropometrics measurements were conducted by a dietitian. The intervention is based on the ASE-model, theory of planned behavior, and motivational interviewing techniques. The intervention included workshops related to stress, eating, sleep, and individual meetings with a dietitian. Multilevel linear mixed models with a random intercept and fixed slope were used to evaluate the impact on lifestyle self-efficacy, eating behavior, anthropometric outcomes and quality of life.

Results Improvements were observed for lifestyle self-efficacy (total: beta= 1.32 95%CI 0.94;1.48, I know: beta= 1.19 95%CI 0.92;1.46, and I can: beta= 1.46 95%CI 1.19;1.73), eating behavior (emotional eating: beta=-0.33 95%CI-0.44;-0.23, external eating: beta=-0.35 95%CI -0.44;-0.26, and diet/restrictive behavior: beta= 0.41 95%CI 0.30;0.51), anthropometric outcomes (weight: beta=-5.03 95%CI -5.93;-4.12, BMI: beta=-1.873 95%CI -2.06;-1.41, waist circumference: beta=-6.83 95%CI -8.00;-5.65, and body fat percentage: beta=-1.80 95%CI -2.48;-1.17) and multiple outcomes of quality of life (physical functioning: beta= 4.43 95%CI 1.98;6.88, vitality: beta= 7.58 95%CI 4.74;10.42, pain:

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beta=4.59 95%CI 0.91;1.827, general health perception: beta= 7.43 95%CI 4.79;10.07, and health change: beta= 21.60 95%CI 16.41;28.80) directly after the intervention. The improvements remained after a six-month follow-up.

Conclusions Multicomponent interventions such as "Healthy and Vital" for healthcare professionals may be useful for improving the health of healthcare workers. More research using other designs with a control group, such as a stepped-wedge or RCT, is needed to verify our findings.

Trial registration Retrospectively registered on May 1 2024 at the Open Science Framework Registries (https://doi.org/10.17605/OSF.IO/Z9VU5).

Keywords Healthcare workers, Eating, Self-efficacy, Nutrition, Quality of life, Women, ASE theory, Theory of planned behavior, Long-term, Motivational interviewing

Background

Working in healthcare often involves stressful situations and a high workload. Healthcare professionals may be exposed to several occupational stressors including time pressure, low social support at work, or emotional responses due to exposure to suffering patients, which could affect the health of healthcare professionals [11, 46, 52]. Ultimately, this could affect the quality of care.

Many healthcare professionals experience burnout complaints or suffer from mental or physical problems. To illustrate, in a cross-sectional Australian study, 53% of the nurses experienced burnout complaints [25]. The prevalence of obesity among healthcare professionals ranged between 14.5% and 31.9% according to a study from England [17]. Recent systematic reviews also demonstrate a possible association with night shifts [19, 45]. Indeed, healthcare workers, especially those performing shift work, more often showed unhealthy lifestyle behaviors, such as snacking during their shifts or insufficient exercise [29, 53].

Besides their work affecting their health by occupational stressors, the work environment of healthcare professionals also creates potential barriers to healthy lifestyle choices. Long shifts, shift work, limited access to fresh products, eating habits of colleagues, lack of motivation, fatigue, and stress are examples of barriers that may make it more difficult to make healthy eating choices [24].

Health problems among healthcare professionals also affect the overall quality of health care. Health problems are one of the most important reasons why healthcare workers such as nurses leave employment [28]. This is still a problem with the current global shortages in healthcare professionals although improvements have been made [22, 54]. Furthermore, mistakes, including but not limited to medication administration or drug prescribing errors, are sometimes caused by the health status (e.g., fatigue or stress), or a high workload of healthcare professionals [16, 26, 47]. Other factors that may be related to medical errors are daytime sleepiness, mental health problems, self-adherence to treatment due to illness, absence due to illness in the past six months, and number of night shifts [3, 43].

In other words, healthy healthcare professionals make fewer mistakes and contribute to better quality of care [38]. According to the World Health Organization, a healthy workplace is a workplace where workers and managers should collaborate to use a continual improvement process to protect and promote the health, safety and well-being of workers and sustainability of the workplace [9]. Multicomponent lifestyle interventions that focus on multiple aspects, such as healthy dietary habits and increasing physical activity, may play a crucial role in improving the health and well-being of healthcare professionals as these tend to be more successful in improving health compared to lifestyle interventions addressing a single aspect [40]. Addressing self-efficacy may also be important in improving lifestyle behavior (e.g., healthy eating and physical activity). Self-efficacy is the confidence and belief that an individual has in the ability to perform a task or certain behavior. People with high self-efficacy are more obliged to perform a task to achieve the desired results [56].

Many previous interventions targeting healthcare professionals were either focused on single aspects of lifestyle or health, or focused mainly on education instead of self-efficacy and other health cognitions [33]. As knowledge about a healthy lifestyle is only one determinant of health behavior, interventions programs focusing solely on education often lead to disappointing results [36]. Furthermore, there is a need for more effective interventions to improve the health of healthcare professionals. When designing lifestyle interventions it is important to ground them in theoretical models, e.g., the theory of planned behavior, health belief or cognitive behavior theory [7]. These theoretical models help understanding behavior change as they specify the mediating variables addressed by the intervention to aid behavior change [6].

To improve the health and well-being of their healthcare workers and to improve quality of care, the Reinier de Graaf (RdG) Hospital developed a multicomponent pilot intervention. The intervention "Healthy and Vital for healthcare professionals (Healthy and Vital)"

addresses stress, sleep, and multiple lifestyle behaviors, with the ultimate aim to improve self-efficacy herein. The intervention is grounded in the theory of planned behavior (i.e., using the attitude-, social norm-, and self-efficacy (ASE)model), social cognitive theory, and motivational interviewing [2, 4, 12]. The ASE-model posits that behavioral change can be predicted by studying behavioral intentions which are influenced by attitudes (A), social norms (S) and self-efficacy (E).

This study aims to evaluate the impact of the pilot intervention "Healthy and Vital" in healthcare professionals on several health-related outcomes (i.e., lifestyle self-efficacy, eating behavior, anthropometric outcomes, and quality of life).

Methods

This study is a pilot study, analyzing hospital data from 2012 to 2018 during the implementation of a lifestyle intervention, which was conducted twice a year. The data collection was intended for quality enhancement at that time and for possible study in the future.

Design and setting of the study

This study is a quantitative pilot evaluation of a lifestyle intervention conducted since 2012. This present analysis uses the data from 2012 to 2018, in which the intervention was delivered 14 times to small groups of participants consisting of 4 to 12 employees.

The study consists of a retrospective single group pre- (multiple) post-test design (i.e. no control group). The study was conducted in one of the Dutch top clinical hospitals (STZ) called the Reinier de Graaf Hospital (RdG). An STZ hospital delivers top clinical care that not all hospitals can deliver with a focus on training, science and innovation. Data were collected at three moments in time. A pre-measurement (baseline/ T1) took place one to three weeks before the start of the intervention. A post-measurement (T2) took place directly after finishing the intervention. The intervention took three months. Finally, a follow-up measurement (T3) took place six months after the intervention was finished. See Fig. 1 for a graphical visualization.

Participants

The intervention targeted healthcare professionals ranging from nurses to the management of the hospital. The multicomponent group lifestyle intervention was actively promoted to healthcare professionals at RdG through various channels including flyers, posters, emails, and the organization's intranet. Participation in the lifestyle intervention was voluntary. If participants wanted to participate, they could do so by registering themselves. In 2023, the RdG had a total of 2,619 employees (83.6% women) [35]. In essence, all healthcare professionals of the RdG were eligible to participate. However, during the intake session with the dietitian, participants were screened for eligibility because they had to be willing to participate Participants were excluded from participation if they suffered from a severe personality or psychiatric disorder, when they could not attend at least ten workshops and four individual consults, or if they needed more personal coaching than that the group intervention could offer. The presence of a serious personality or psychiatric disorder was discussed during the first session following registration. However, no clinical assessment or diagnosis was conducted. This was determined subjectively by the dietitian. There is no track of how many healthcare professionals have been excluded.

Data were collected from 2012 to 2018 for quality assurance purposes. Before filling out the questionnaires participants were made aware that participation was voluntary and also for the purpose of (future) research. An

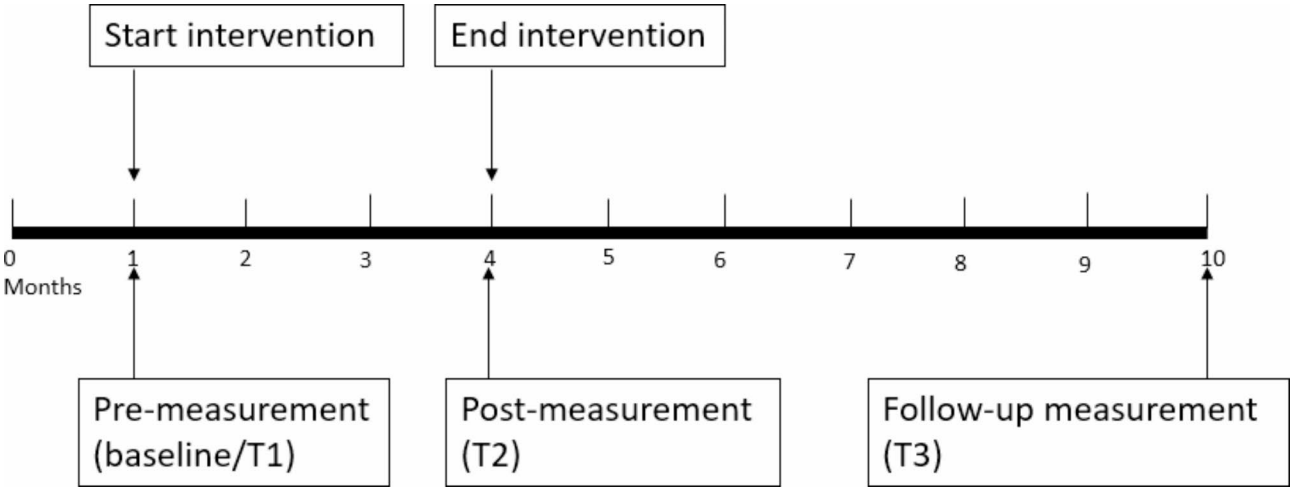

Fig. 1 Graphical overview of the data collection of the "Healthy and Vital" intervention in months

opt-out procedure was implemented at the time of the current data-analysis, allowing all participants the choice to decline the use of their data in this current analysis. The opt-out procedure included information on this present analysis and participants had to respond within two weeks if they did not want us using their data for this current analysis.

In total, 130 participants were found to be eligible and participated in the intervention. Of these participants, 2 refused participation in the present data analysis using the opt-out procedure. Furthermore, because of possible privacy concerns, two other participants were not included in this present analysis because they were the only males that participated. The final population of analysis included 126 participants.

Finally, of these 126 participants who all started the intervention and filled out the pre-measurement (T1), 110 remained in the intervention and filled out the post-measurement (T2). Of all 126 participants, 99 attended the follow-up meeting and filled out the follow-up measurement (T3). Four participants missed measurement 2 but were present at the follow-up meeting and filled out T3. In total 31 participants missed one or two measurements and 27 missed both the post-and follow-up measurement. See also Fig. 2.

Power calculation

In this retrospective pre- (multiple) post-test pilot study, the relevance of a power calculation is limited to predicting the probability of finding results. Exploratory research was conducted to examine whether the intervention was associated with better lifestyle self-efficacy, eating behavior, anthropometric outcomes, and quality of life. For the outcome measures power calculations were performed with a power of 0.80 and a two-sided significance level of 0.05. The power ranged between 64 (Eating Behavior "Emotional eating"), to 67 (Quality of Life "General health perception"), to 75 (Self-efficacy "I know") to 96 (body mass index) per measurement moment. Only for health change (Quality of Life outcome indicator) we would need 124 participants per measurement; hence, no sufficient power. See appendix 1 for the full exact power calculations [18]. This shows that there is sufficient power for the analysis to detect significant differences over time.

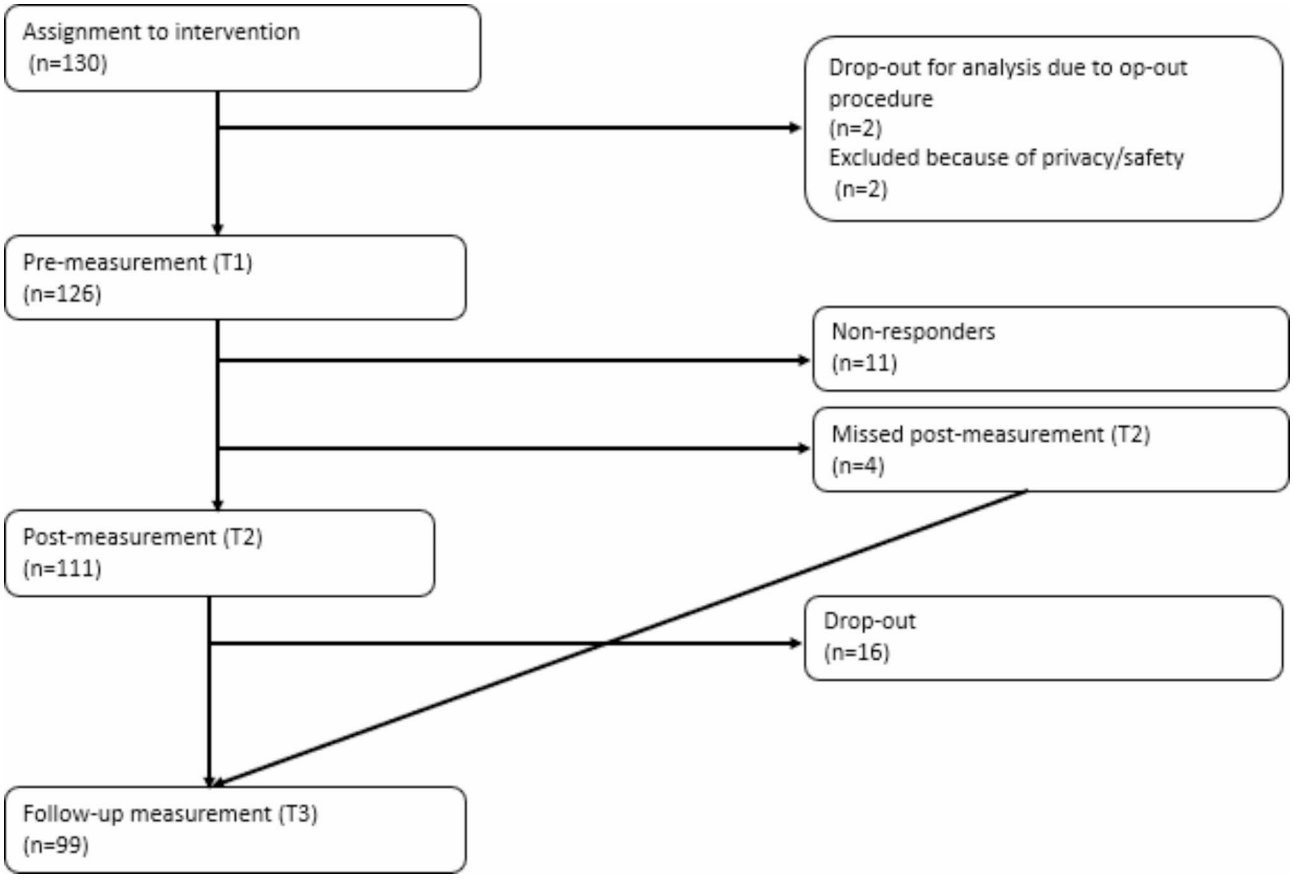

Fig. 2 Flow chart of the analysis

Description of the intervention

The intervention called "Gezond en Vitaal" or in English "Healthy and Vital" is a service set up for healthcare professionals of the RdG. The intervention is designed to improve health of the workers which is hypothesized to improve the quality of care for patients. Improvements in quality of care were not measured.

The theoretical foundation for this intervention is based on the idea that knowledge alone about a healthy lifestyle is not sufficient to lead a healthy lifestyle; health literacy is essential. This includes setting realistic goals, getting started, and sustaining efforts and dealing with emotions and setback (resilience). Health literacy also encompasses having adequate awareness of the connection between behavior and health, as well as possessing self-confidence (self-efficacy) to make lifestyle changes [13]. Furthermore, some individuals may experience too much stress, or find lifestyle changes too difficult due to their socioeconomic position [50].

The "Healthy and Vital" multicomponent lifestyle intervention is based on the ASE-model and theory of planned behavior [2, 12]. This ASE-model assumes that the intention and the subsequent behavior are determined by attitudes, social norms, and social influences and by self-efficacy. However, if present, a lack of knowledge and other barriers (e.g. stress at the workplace) can affect the preferred behavior. More precisely, the intervention was based on the integrated change model (i.e. I-change) which is the more integrated subsequent model of the ASE-model, which includes 5 different theories: the transtheoretical theory, theory of planned behavior, goal setting theory, health belief model, and social cognitive theory [2, 4, 5, 20, 30, 37).

Furthermore, the intervention employs motivational interviewing techniques, for which more research is still needed to prove its effectiveness [14]. Motivational interviewing can be used to support forming intentions and tools for self-efficacy and dealing with barriers. The intervention uses different techniques for behavior change based on a list that Abrahams and Michie developed and reflects the underlying theories of this intervention. These techniques are for example working on the attitude towards the preferred behavior, which is one of the components of the ASE-model [1, 13].

Before the start of the intervention, screening for eligibility took place followed by an individual 90-minute intake session with a dietitian. During this intake session the data collection for the pre-measurement (T1) took place. Anthropometric data were collected by the dietitian, and participants were provided with an online questionnaire to complete at home. During this first session several matters were discussed: current lifestyle, environmental factors, motivation, and food intake and eating. Based on this information, each participant received an individual daily meal plan. This intake session took place one to three weeks before the start of the actual lifestyle intervention.

During the intervention over the next 12 weeks, 12 2.5 h workshops were given. Workshops were provided by experts, such as a lifestyle coach, internist, psychologist, exercise expert, dietitian, mindfulness trainer, medical officer and a chef. Topics discussed during the workshops included: motivation; health at work; energy management; time management; nutrition; mindfulness, thought record which is part of cognitive behavior therapy (CBT), sleep, hormones in relation to weight and nutrition, working of the brain in relation to changing behavior, goalsetting, how to involve "environment", and how to deal with a relapse. Each workshop was evaluated by the participants on how much they liked the workshop.

Alongside the workshops, participants were offered three individual 30-minute follow-up sessions with the dietitian. These sessions were designed to help participants acquire improved health skills. Daily meal plans underwent revisions, and discussions were held regarding individual challenges and strategies for relapse prevention.

Data collection for the post-measurement (T2) was conducted after the conclusion of the final workshop was performed. The dietitian measured anthropometric outcomes and online questionnaires were given to the participants to complete at home (similar to T1).

The group of participants met again six months after completing the intervention for a 2.5 h follow-up session led by a lifestyle coach. After this follow-up session, data collection for the follow-up measurement (T3) took place. Anthropometrics outcomes were assessed by a dietitian, and participants were provided with online questionnaires to complete at home (similar to T1/T2). Additionally, participants' experiences, such as their level of satisfaction with (e.g. how much participants liked the intervention), were discussed.

The lifestyle coach discussed with the trainers/experts what the expectations were and what was going on in each group [23].

Measures

Lifestyle self-efficacy

Lifestyle self-efficacy was measured using a questionnaire that was developed by the RdG for this lifestyle intervention (appendix 2). The lifestyle self-efficacy questionnaire consisted of six questions. In total, six questions were used to compute lifestyle self-efficacy. Each question consisted of two sub-questions, namely 1) "I know" and 2) "I can". All questions could be answered by how much they agreed with the question on a ten-point Likert scale,

with 1 equaling "disagree" and 10 "agree". The questions included the following topics:

I know/ I can:

- motivate myself to follow a healthy lifestyle;
- implement a healthy exercise pattern;
- recognize undermining thoughts in myself;
- prevent myself from making choices that are unhealthy for me;
- how to buy groceries wisely/ how to do healthy grocery shopping;
- set realistic goals to improve my lifestyle.

From this questionnaire we computed three outcome variables: "I know", "I can" and "total lifestyle self-efficacy". We added up the scores of all six (for I know and I can) or twelve (for total self-efficacy) questions. Subsequently, we divided this by the total number of questions per scale (i.e. six or twelve). The scores ranged between 1 and 10 with higher scores indicating better self-efficacy. The "I know" (Cronbach's a=0.82), "I can" (Cronbach's a=0.85), and "total lifestyle self-efficacy" (Cronbach's a=0.90) had good internal consistency.

Eating behavior

Eating behavior was measured using the validated Dutch Questionnaire for Eating Behavior (NVE) which consists of 33 statements [51]. Participants scored their level of agreement with each statement using a 5-point Likert scale ranging from never, rarely, sometimes, often to very often. Based on these answers, three scales were computed: emotional eating, external eating, and diet/ restrictive-oriented eating. All scales were computed by summing up the responses to the questions related to that particular scale and then dividing this by the scale's number of questions, in accordance with the NVE manual.

For participants who skipped more than 1 question, the average scale score was not calculated, in agreement with the NVE manual. However, no participant skipped more than 1 question. For participants who skipped 1 question, the average scale score was calculated by dividing the score by the number of questions that had been answered (following the NVE manual). All scales ranged between 1 and 5 with lower scores indicating better eating behavior outcomes on all scales.

Anthropometrics

Several anthropometric outcomes were assessed by the dietitian: height, body weight, body fat percentage and waist circumference. Each participant was measured using a standard height meter attached to the wall, as is customary in consultation rooms. Weight and body fat percentage were determined with a calibrated scale (TANITA BC-420MA), and waist circumference with a simple measuring tape. From the measured height and weight, body mass index (BMI) was computed by dividing weight in kilograms by height in meters squared. From the measured height and weight, BMI was computed by dividing weight in kilograms by height in meters squared.

Quality of life

Quality of life was measured with the Dutch version of the validated RAND-36 questionnaire [49]. This questionnaire consists of 11 questions across 8 scales and one single item. For 6 of the 8 scales, a response is requested on a three- to six-point Likert scale (i.e. physical functioning, social functioning, mental health, vitality, bodily pain, and general health perception). The other two scales have a "yes/no" response option (i.e., role (physical) and role (emotional). Each scale consists of several items. The score of these different items added together forms the scale score. Recoding was performed according to the guidelines described in the manual. The scale scores were subsequently transformed to hundred-point scales using the following formula: transformed scale score = ((raw scale score – minimum raw scale score) / score range) * 100. Below, all scales and the single item are described more extensively.

Quality of life: physical functioning

The physical functioning scale measured the amount of limitations in daily activities that a person experienced as a result of health problems. The scale consisted of ten items, which include climbing stairs, washing, dressing, carrying groceries, etc. All ten items were measured on a 3-point Likert scale: "yes, severely limited", "yes, somewhat limited", and "no, not limited at all". The physical functioning scale ranged between 10 and 30 before the transformation to a 100-point scale. A higher score indicated fewer indicates less limitations. With a low score, limitations were experienced with even the most basic tasks, such as getting dressed.

Quality of life: social functioning

The social functioning scale included two items about physical or emotional limitations experienced in participating in social activities. The question about the experience of impairment in social functioning over the past 4 weeks had to be answered on a 5-point Likert scale with: "not at all", "somewhat", "quite a bit", "a lot", and "very much". The question about how often you limited physical or emotional complaints in the past 4 weeks also had to be answered on a 5-point Likert scale with: "constantly", "usually", "sometimes", "rarely" and, "never". The score ranged from 2 to 10 before the transformation to a 100-point scale. A higher score indicated fewer

limitations to participating in daily social activities. With a low score, someone experiences many physical or emotional limitations in participating in social activities.

Quality of life: role limitations (physical problem)

The role limitations (physical problem) scale included four items about difficulties at work and participation in other daily activities that a person undergoes as a result of physical health problems. The questions had 2 answer options: "yes" and "no". The score ranged between 4 and 8 before transformation to a 100-point scale. A higher score indicates no problems in daily activities and work. A low score indicates problems with daily activities or work due to physical health problems.

Quality of life: role limitations (emotional problem)

The role limitations (emotional problem) scale included three items that measured the limitations that someone experiences in participating in daily activities and work as a result of emotional problems. The questions had 2 answer options: "yes" and "no". The score ranged between 3 and 6 before transformation to a 100-point scale. A higher score indicates no problems in daily activities and work. A low score indicates problems with daily activities or work due to emotional health problems.

Quality of life: mental health

The mental health scale included five items about feelings of depression and nervousness. The questions about mood and the frequency of that mood had 6 answer options: "constantly", "usually", "often", "sometimes", "rarely", and "never". The score ranged between 5 and 30 before transformation to a 100-point scale. A higher score indicates less feelings of depression and nervousness. A low score indicates feelings of depression and nervousness in recent weeks.

Quality of life: vitality

The vitality scale included 4 items that focus on how vital and energetic a person feels. The questions had 6 answer options: "constantly", "usually", "often", "sometimes", "rarely" and "never". The score ranged between 4 and 24 before transformation to a 100-point scale. A higher score indicates less fatigue complaints (i.e. more vitality an energy) and a low score indicates more fatigue complaints.

Quality of life: bodily pain

The bodily pain scale included two questions about how much pain and how many limitations due to pain are experienced. One question was: "How much physical pain did you have in the past 4 weeks?" This question had to be answered on a 6-point Likert scale ranging from: "none", "very mild", "quite a bit", "severe" and "very severe". The other question was about hindrance due to pain complaints and had to be answered on a 5-point Likert scale ranging from: "not at all", "a little bit", "quite a bit", "a lot", and "very much". The score ranged between 11 and 60, before transformation to a 100-point scale. With a higher score, fewer pain complaints were experienced. A low score indicates a lot of pain and experiencing limitations.

Quality of life: General health perception

The general health perception scale included five items that subjectively measure perceived health. One item about general health had to be answered on a 5-point Likert scale with the following response options: "excellent", "very good", "good", "moderate" and "poor". The other four items about health had 5 answer options: "completely correct", "largely correct", "I don't know", "largely incorrect" and "completely incorrect". The score ranged between 5 and 25, before transformation to a 100-point scale. A higher score indicated that someone perceived their health better/higher (e.g., excellent). A low score indicates that someone perceived their health as poor and expected deterioration rather than improvement.

Quality of life: health change

Health change was measured using the question: "Compared to a year ago, how would you rate your health in general now?" The question had 5 answer options on a Likert-scale ranging from 1 "much better than a year ago" to 5 "much worse than a year ago". The score ranged between 1 and 5, before transformation to a 100-point scale. A higher score indicates that someone perceived their health as improved.

Covariates

Covariates were selected based on theory and previous research. Age, educational level, and household situation were obtained via the questionnaires that participants filled out at the pre-measurement moment (T1). An older age may be a potential barrier for lifestyle behavior change whereas it has been found in previous research that being in a single household might foster behavior change. Findings regarding educational level are unclear. Burgess et al. [8] We hypothesized that a lower educational level may be a barrier for behavior change due to low literacy or specific stressors as this can influence lifestyle self-efficacy. Age was measured using date of birth and computed as age continuously in years. Educational level was measured by the following question: "What is your highest level of education that you completed with a degree?". The question had eight answer categories: "primary education", "secondary education", "prevocational secondary education", "secondary vocational education", "upper secondary education / pre-university

education", "higher professional education" and "university education". Educational level was categorized as lower (primary education, secondary education, pre-vocational secondary education), intermediate (secondary vocational education, upper secondary education / pre-university education), and higher education (higher professional education and university education) according to the ISCED classification using the latter as a reference category [42]. Household situation was measured by the question: "What is your marital status?" with the following response options: "single", "married", "living together", and "widow(er)". Marital status was categorized as single-person household (i.e. "single" and "widow(er)", or multiple-person household (i.e. "married" and "living together") with the latter as the reference category.

Statistical analysis

The normality of the continuous data was inspected using skewness and kurtosis and found to be normally distributed. Descriptive statistics (i.e., for continuous data the mean and standard deviation (SD) and for categorical data percentages and numbers) were used to describe the participants. Chi-square and ANOVA tests were performed to test for differences between the measurement moments.

Subsequently, associations of the intervention with all outcomes were assessed using multilevel multivariable linear regression analysis. A random intercept and a fixed slope model was used to compute the beta and corresponding 95% confidence interval (CI). For the random intercept, a variance components covariance structure and for the fixed effect, a scaled identity covariance structure was used, and Satterthwaite degrees of freedom were chosen. Two models were computed, a crude unadjusted model (model 1) and a confounder-adjusted model that included age (continuous), educational level (ref=higher), and household status (ref=multiple-person household).

Before the analysis, assumptions were checked and deemed not violated: Pearson's correlation coefficients were assessed to check for multicollinearity (all between −0.7 and 0.7), Durbin-Watson statistics were used to assess the assumption that the values of the residuals were independent (all between 1 and 3), scatterplots to assess the assumption that the variance of residuals was constant, and P-P-plots to assess the assumption that the values of the residuals were normally distributed. Cook's Distance values were calculated to ensure that no influential cases were biasing the model (all < 1).

Missing data were not imputed because our analysis used the last-value carried forward principle. As a result no cases from the 126 participants that started with the intervention were excluded because of missing data or when they dropped-out during the intervention (i.e., an intention-to-treat analysis)." The observation that participants with a higher starting weight were more likely to drop out of the intervention, leading to missing data at T2 or T3, may not have resulted in an overestimation of the intervention's success, as these participants were still included in the analyses.

A Bonferroni correction ($p<0.05/4=<0.0125$) was used as sensitivity analysis. We corrected the significance based on the 4 main outcomes (i.e., self-efficacy, eating behavior, anthropometric outcomes and quality of life). Finally, a non-response analysis was performed to check for differences at pre-measurement between participants who completed all measurements and participants who missed one or two measurements. For the non-response analysis, descriptive statistics (i.e., for continuous data the mean and standard deviation (SD) and for categorical data percentages and numbers) were computed, and differences were tested using t-tests and chi-square tests.

All p-values were two-tailed and the level of significance was set at 0.05. Although the outcomes may not be fully independent from each other, Bonferroni correction was additionally applied to account for potential inflation of type I errors. Statistical analyses were performed using IBM SPSS statistics for Windows, version 29.0 (International Business Machines Corporation, Armonk, New York).

Results

Table 1 shows the characteristics of the study sample. The mean age of the participants was 49.1 (SD 7.9) years. Most participants had an intermediate level of education, followed by a higher educational level. Most participants were living together in a household. Participants had a mean BMI of 30.9 kg/m2, which is considered obese. At later measurement moments, self-efficacy was significantly higher. (i.e., better). "Emotional eating" and "external eating" were significantly lower at later measurement moments whereas "diet/restrictive eating" was higher. Mean weight, BMI, waist circumference and body fat percentage were significantly lower at later measurement moments. Regarding quality of life, "vitality", "general health perception" and "health change" were significantly higher at later measurement moments. The quality of life outcomes "vitality", "general health perception" and "health change" were somewhat lower compared to scores in the manual.

Table 2 shows the results of the impact of the intervention on lifestyle self-efficacy outcomes. We observed a positive increase in total self-efficacy as well as the I know and the I can scale at the post-measurement and the follow-up measurement. After a Bonferroni correction, the outcomes remained significant. The model fit is shown in appendix 3.

Table 1 Characteristics of the healthcare professionals

	Participants at T1 ($n=126$)	Participants at T2 ($n=111$)	Participants at T3 ($n=99$)	*P*-value
Sociodemographic characteristics				
Age, M (SD)	49.1 (7.9)	49.2 (8.0)	49.3 (778)	0.959
Educational level[1]				
Lower	19 (15.3%)	19 (17.3%)	15 (15.3%)	0.976
Intermediate	58 (46.8%)	47 (42.7%)	45 (45.9%)	
Higher	47 (37.9%)	44 (40.0%)	38 (38.8%)	
Household status[2]				0.943
Multiple-person	98 (77.8%)	86 (78.2%)	74 (76.3%)	
Single-person	28 (22.2%)	24 (21.8%)	23 (23.7%)	
Lifestyle self-efficacy outcomes				
Self-efficacy total, M (SD)[3]	6.0 (1.2)	7.4 (1.2)	7.2 (0.9)	< 0.001
Self-efficacy I know, M (SD)[3]	6.4 (1.3)	7.6 (1.2)	7.6 (1.0)	< 0.001
Self-efficacy I can, M (SD)[3]	5.7 (1.3)	7.1 (1.2)	6.9 (1.1)	< 0.001
Eating behavior outcomes				
Emotional eating, M (SD)[4]	3.0 (0.8)	2.7 (0.8)	2.8 (0.8)	0.003
External eating, M (SD)[4]	3.1 (0.6)	2.8 (0.6)	2.9 (0.6)	< 0.001
Diet/restrictive eating, M (SD)[4]	3.0 (0.6)	3.4 (0.6)	3.4 (0.5)	< 0.001
Anthropometric outcomes				
Height, M (SD)[5]	1.70 (0.1)	1.70 (0.1)	1.70 (0.1)	0.564
Weight, M (SD)[6]	88.8 (17.1)	82.4 (15.5)	81.9 (15.1)	0.003
BMI, M (SD)[7]	30.9 (5.8)	28.6 (5.1)	28.9 (5.7)	0.005
Waist circumference, M (SD)[8]	104.9 (12.9)	97.1 (12.1)	96.5 (12.6)	< 0.001
Body fat percentage, M (SD)[9]	41.7 (5.7)	39.5 (6.2)	38.7 (6.9)	0.002
Quality of life outcomes				
Physical functioning, M (SD)[10]	82.5 (17.0)	87.3 (16.0)	85.7 (18.5)	0.094
Social functioning, M (SD)[10]	80.1 (20.5)	82.7 (20.7)	84.1 (21.6)	0.355
Role function (physical problem), M (SD)[10]	78.2 (33.0)	81.1 (34.8)	84.9 (30.0)	0.323
Role function (emotional problem), M (SD)[10]	84.8 (31.3)	86.3 (29.3)	86.5 (31.2)	0.902
Mental health, M (SD)[11]	73.5 (13.9)	75.1 (14.8)	76.1 (13.3)	0.376
Vitality, M (SD)[10]	54.3 (17.7)	62.8 (18.6)	62.1 (18.8)	< 0.001
Pain, M (SD)[10]	74.9 (23.7)	75.8 (22.0)	78.1 (23.6)	0.233
General health perception, M (SD) [11]	60.9 (18.3)	69.2 (16.6)	69.6 (18.0)	< 0.001
Health change, M (SD)[10]	48.0 (22.1)	69.6 (24.0)	67.4 (23.8)	< 0.001

Percentages are valid percentages (i.e., calculated without the missing values) and column percentages. Chi-square tests were used to test for differences in categorical variables and ANOVA tests were used to test for differences in continuous variables. [1] 2 missing values at T0, 1 at T1 and 1 at T2. [2] 1 missing value at T1 and 2 at T2. [3] 1 missing value at T1. [4] 2 missing values at T0, 5 missing at T1 and 3 missing at T2. [5] 1 missing value at T0, 7 missing at T1 and 31 missing at T2. [6] 2 missing values at T0, 9 missing at T1 and 30 missing at T2. [7] 2 missing values at T0, 9 at T1 and 31 at T2. [8] 4 missing values at T0, 12 missing at T1 and 38 at T2. [9] 2 missing values at T0, 9 at T1 and 34 at T2. [10] 12 missing values at T0, 4 at T1 and 4 at T2. [11] 13 missing values at T0, 4 at T1 and 4 at T2

Table 2 Impact of the intervention on lifestyle self-efficacy outcomes post-intervention and at follow-up

	Model 1 beta (95%CI)					Model 2 beta (95%CI)				
	T1	T2	*P*-value	T3	*P*-value	T1	T2	*P*-value	T3	*P*-value
Total self-efficacy	ref	**1.32 (1.06;1.57)**	< 0.001	**1.20 (0.94;1.47)**	< 0.001	ref	**1.32 (1.07;1.58)**	< 0.001	**1.21 (0.94;1.48)**	< 0.001
I know	ref	**1.19 (0.92;1.45)**	< 0.001	**1.22 (0.94;1.50)**	< 0.001	ref	**1.19 (0.92;1.46)**	< 0.001	**1.22 (0.94;1.51)**	< 0.001
I can	ref	**1.45 (1.18;1.72)**	< 0.001	**1.18 (0.91;1.46)**	< 0.001	ref	**1.46 (1.19;1.73)**	< 0.001	**1.19 (0.90;1.47)**	< 0.001

Mixed model analyses using a random intercept and fixed slope model with Satterthwaite residuals; a variance components covariance structure for random effects, and a scaled identity covariance structure for fixed effects. Model 1 is a crude, unadjusted model. Model 2 is adjusted for age (continuous), educational level (ref=higher), and household status (ref=multiple-person). **Bold** indicates a significant association ($p<0.05$). Intraclass correlation (ICC) and Akaike's Information Criteria (AIC) are reported in appendix 3

Table 3 shows the impact of the intervention on eating behavior outcomes. We observed a positive impact, i.e. a decrease in emotional eating and external eating scales at the post-measurement, and the follow-up measurement. We also observed a significant increase on the diet/restrictive eating scale (i.e. more diet/restrictive eating behavior) at the post-measurement and the follow-up measurement. After Bonferroni's correction, the outcomes remained significant. The model fit is shown in appendix 3.

Table 3 Impact of the intervention on eating behavior outcomes post-intervention and at follow-up

	Model 1 beta (95%CI)					Model 2 beta (95%CI)				
	T1	T2	*P*-value	T3	*P*-value	T1	T2	*P*-value	T3	*P*-value
Emotional eating	ref	**-0.33 (-0.43;-0.23)**	< 0.001	**-0.23 (-0.34;-0.12)**	< 0.001	Ref	**-0.33 (-0.44;-0.23)**	< 0.001	**-0.22 (-0.33;-0.11)**	< 0.001
External eating	ref	**-0.34 (-0.44;-0.25)**	< 0.001	**-0.26 (-0.35;-0.16)**	< 0.001	Ref	**-0.35 (-0.44; -0.26)**	< 0.001	**-0.25 (-0.35;-0.15)**	< 0.001
Diet/restrictive eating	ref	**0.41 (0.31;0.51)**	< 0.001	**0.36 (0.25–0.46)**	< 0.001	Ref	**0.41 (0.30, 0.51)**	< 0.001	**0.36 (0.25; 0.47)**	< 0.001

Mixed model analyses using a random intercept and fixed slope model with Satterthwaite residuals, a variance components covariance structure for random effects, and a scaled identity covariance structure for fixed effects. Model 1 is a crude, unadjusted model. Model 2 is adjusted for age (continuous), educational level (ref = higher) and household status (ref = multiple-person). **Bold** indicates a significant association ($p < 0.05$). *Indicates non-significance after a Bonferroni correction ($p = 0.05/4) = 0.0125$. Intraclass correlation (ICC) and Akaike's Information Criteria (AIC) are reported in the appendix 3

Table 4 Impact of the intervention on anthropometric outcomes post-intervention and at follow-up

	Model 1 beta (95%CI)					Model 2 beta (95%CI)				
	T1	T2	*P*-value	T3	*P*-value	T1	T2	*P*-value	T3	*P*-value
Weight	ref	**-4.97 (-5.86; -4.09)**	< 0.001	**-4.87 (-5.91;-3.83)**	< 0.001	ref	**-5.03 (-5.93;-4.12)**	< 0.001	**-4.77 (-5.84;-3.70)**	< 0.001
BMI	ref	**-1.72 (-2.04; -1.41)**	< 0.001	**-1.72 (-2.10;-1.35)**	< 0.001	ref	**-1.74 (-2.06;-1.41)**	< 0.001	**-1.69 (-2.07;-1.30)**	< 0.001
Waist circumference	ref	**-6.70 (-7.85; -5.54)**	< 0.001	**-726 (-8.68;-5.85)**	< 0.001	ref	**-6.83 (-8.00;-5.65)**	< 0.001	**-7.00 (-8.44;-5.57)**	< 0.001
Body fat percentage	ref	**-1.73 (-2.33; -1.12)**	< 0.001	**-2.20 (-2.92;-1.47)**	< 0.001	ref	**-1.80 (-2.43;-1.17)**	< 0.001	**-2.12 (-2.88;-1.36)**	< 0.001

Mixed model analyses using a random intercept and fixed slope model with Satterthwaite residuals, a variance components covariance structure for random effects, and a scaled identity covariance structure for fixed effects. Model 1 is a crude, unadjusted model. Model 2 is adjusted for age (continuous), educational level (ref = higher) and household status (ref = multiple-person). **Bold** indicates a significant association ($p < 0.05$). *Indicates non-significance after a Bonferroni correction ($p = 0.05/4) = 0.0125$. Intraclass correlation (ICC) and Akaike's Information Criteria (AIC) are reported in the appendix 3

Table 5 Impact of the intervention on quality of life outcomes post-intervention and at follow-up

	Model 1 beta (95%CI)					Model 2 beta (95%CI)				
	T1	T2	*P*-value	T3	*P*-value	T1	T2	*P*-value	T3	*P*-value
Physical functioning	Ref	**4.37 (1.93;6.81)**	< 0.001	**3.37 (0.83;5.90)**	0.010	Ref	**4.43 (1.98;6.88)**	< 0.001	**3.15 (0.58;5.72)**	0.016
Social functioning	Ref	2.38 (-1.80;6.56)	0.263	3.60 (-0.73;7.92)	0.103	Ref	2.35 (-1.81;6.51)	0.267	3.97 (-0.39;8.33)	0.074
Role function (physical problem)	Ref	3.14 (-3.92;10.19)	0.382	6.58 (-7.30;1389)	0.077	Ref	3.42 (-3.66;10.50)	0.342	6.92 (-0.49;14.33)	0.067
Role function (emotional problem)	Ref	1.11 (-6.11;8.33)	0.762	1.63 (-5.83;9.09)	0.668	Ref	1.35 (-5.99;8.69)	0.717	1.55 (-6.11;9.21)	0.690
Mental health	Ref	0.69 (-1.28;3.20)	0.398	**2.44 (0.11;4.76)**	0.040*	Ref	0.71 (-1.52;2.95)	0.530	2.12 (-0.23;4.46)	0.077
Vitality	Ref	**7.82 (5.00;10.64)**	< 0.001	**7.22 (4.29;10.15)**	< 0.001	Ref	**7.58 (4.74;10.42)**	< 0.001	**7.06 (4.08;10.03)**	< 0.001
Pain	Ref	**4.53 (0.91;8.15)**	0.014*	2.37 (-1.39;6.13)	0.215	Ref	**4.59 (0.91;8.27)**	0.015*	2.40 (-1.46;6.26)	0.222
General health perception	Ref	**7.36 (3.73;9.99)**	< 0.001	**8.02 (5.27;10.76)**	< 0.001	Ref	**7.43 (4.79;10.07)**	< 0.001	**7.99 (5.20;10.77)**	< 0.001
Health change	Ref	**21.41 (16.24;26.59)**	< 0.001	**19.27 (13.91;24.63)**	< 0.001	Ref	**21.60 (16.41;26.80)**	< 0.001	**19.13 (13.71;24.56)**	< 0.001

Mixed model analyses using a random intercept and fixed slope model with Satterthwaite residuals, a variance components covariance structure for random effects, and a scaled identity covariance structure for fixed effects. Model 1 is a crude, unadjusted model. Model 2 is adjusted for age (continuous), educational level (ref = higher) and household status (ref = multiple-person). **Bold** indicates a significant association ($p < 0.05$). *Indicates non-significance after a Bonferroni correction ($p = 0.05/4) = 0.0125$. Intraclass correlation (ICC) and Akaike's Information Criteria (AIC) are reported in the appendix 3

Table 4 shows the impact of the intervention on anthropometric outcomes. We observed a positive decrease in weight, BMI, waist circumference, and body fat percentage at the post-measurement and at the follow-up measurement. After Bonferroni's correction, the outcomes remained significant. The model fit is shown in the appendix 3.

Table 5 shows the impact of the intervention on quality of life outcomes. A positive increase (i.e. a positive effect) was observed for physical functioning, vitality, pain, general health perception, and health change post-intervention and at the follow-up measurement. For mental health a positive increase was only observed directly post-intervention and not at the follow-up measurement

After Bonferroni's correction, mental health and pain were no longer significant. The model fit is shown in the appendix 3.

The non-response analysis indicated no significant differences between the complete responders and participants who missed one or two measurement moments, except for the anthropometric outcomes. Non-responders had a statistically significant higher weight, BMI, and body fat percentage. The data are shown in appendix 4.

Discussion

In this study of Dutch healthcare professionals who followed a multicomponent lifestyle intervention called "Healthy and Vital", we observed improvements in lifestyle self-efficacy, eating behavior, anthropometric outcomes, and some indicators of quality of life directly after the 3-month intervention and after six months.

Lifestyle self-efficacy was improved in healthcare professionals who participated in the "Healthy and Vital" multicomponent lifestyle intervention. The healthcare workers scored higher on total self-efficacy, on their knowledge about healthy lifestyle behaviors and on the ability to perform healthy lifestyle behaviors. Moreover, this increase in self-efficacy was observed not only directly after finishing the intervention but also lasted after a 6-month follow-up. The intervention highly focused on addressing lifestyle self-efficacy as this is seen as one of the crucial components of the ASE-model and theory of planned behavior, the theoretical foundation for the "Healthy and Vital" lifestyle intervention [2, 12]. The intervention employed amongst others behavior change techniques that were found suitable for behavior change [1, 13]. For example, providing information about the link between behavior and health, making concrete goals (intention formulation), evaluating and adjusting goals, and providing information about consequences, and goals setting for after the intervention. When looking at the ASE-model, one may postulate self-efficacy may thus be an essential element when aiming to improve lifestyle behavior.

Besides improvements in self-efficacy, we observed a potential improvement from this multi-component lifestyle intervention on eating behavior. The healthcare professionals improved on emotional eating and external eating and showed more diet/restrictive behavior. These findings are in correspondence with earlier research that reported several barriers of healthy eating habits among healthcare professionals such as time tables, high work demands, work culture, social norms, stress, fatigue, personal values beliefs. The multicomponent lifestyle intervention also addressed aspects such as stress, sleeping and social norms potentially impacting these barriers. Supportive networks and attitudes were identified as enablers, which were also addressed in the "Healthy and Vital" lifestyle intervention [21]. This supports the idea that a multi-component intervention is needed to adequately address eating behavior. The "Healthy and Vital" lifestyle intervention is such an intervention founded on the ASE-model and theory of planned behavior addressing social norms/influences, attitudes and barriers improving behavioral outcomes. Indeed, also in a systematic review to workplace interventions to improve the health of hospital workers it was reported that multicomponent strategies such as Healthy and Vital were most successful in chancing nutritional behavior [55]. In another systematic review about lifestyle health promotion interventions for nurses, it was observed that interventions that focus on changing nutritional behavior commonly resulted in improved results, particularly when education was included in the intervention [41]. Furthermore, the intervention also addressed physical activity. Unfortunately, physical activity was not adequately measured during this intervention. Interestingly, the positive changes were also reflected in favorable changes in anthropometric outcomes. The healthcare workers significantly reduced their weight, BMI, waist circumference and body fat percentage. This may be a reflection of their changes in eating behavior. Other studies performed in healthcare workers also reported positive results on anthropometric outcomes from multicomponent lifestyle interventions [10, 34].

Ultimately, the multicomponent "Healthy and Vital" lifestyle intervention was developed to improve overall well-being of healthcare professionals at the RdG hospital to ultimately improve the quality of care. This could be done by examining outcome indicators such as mortality rates, readmission rates, waiting times, early discharges and PROMS (patient reported outcome measures) or by structural or process indicators such as availability of staff, burn-out of staff, using best practices and (PREMS) patient reported experience measures [32].

Quality of life can be seen as an indicator of well-being, which is recognized as essential for good quality patient care, safety, and performance. Improving the quality of life of healthcare professionals is therefore not only important for healthcare professionals themselves but also for the quality of care and health of the patients [27]. We evaluated the impact of the "Healthy and Vital" multicomponent lifestyle intervention and found improvements on multiple quality of life outcomes: physical functioning, vitality, pain, general health perception and health change. In the previous systematic review by Stanulewics et al., that included 136 studies of which 23 to well-being outcomes mixed results were observed and also in an earlier study about multicomponent intervention no effects were found on quality of life [41, 48]. A positive impact was reported in 14 studies, whereas in 9 no effects were found [41]. It may take a longer time

to change quality of life and most studies in this review only measured quality of life directly after the intervention. Our study also included a follow-up measurement showing a sustained improvement on some of the quality of life indicators.

All positive outcomes that we observed directly after the lifestyle intervention also remained until the 6-months follow-up measurement. During the 6-months follow-up period, no workshops, sessions or additional information was given. This indicates that the multicomponent lifestyle intervention may also be an effective intervention in the long-run. Inconclusive evidence about longer-term findings is reported by a systematic review of reviews studying the effectiveness of work place interventions on physical and mental health outcomes. In this review-of-reviews the authors mentioned that multicomponent lifestyle interventions might improve longer-term weight-related outcomes however, evidence so far is inconclusive [31].

Methodological considerations

Strengths of our study include the real-life implementation of this multicomponent intervention. Real-life implementation can increase the external validity (generalizability). Another strength is that the lifestyle intervention has a theoretical foundation based on the ASE-model, theory of planned behavior, and motivational interviewing techniques, and consists of multiple components to address and improve the lifestyle and well-being of the healthcare professionals. Focusing on education and providing information only is hardly sufficient to reach behavior change [44]. Furthermore, a relatively large share of our population had an intermediate educational level while many workplace interventions focus on or reach highly educated (e.g., university degree) participants [36]. Our findings may not be generalizable to participant groups with higher educational level or vice versa.

However, this study has some important limitations that need to be taken into consideration. First of all, the design used for the evaluation of the "Healthy and Vital" intervention lacks a comparator/ control group reducing the internal validity. Unfortunately, performing a randomized controlled trial (RCT) was not possible and we had to rely on routinely collected data for quality improvement purposes [39]. Therefore, we cannot be certain that the observed changes in the outcomes are indeed caused by the intervention or that they are due to external circumstances/ chance.

Second, as per coincidence only women were included in this study, unfortunately. Caution is needed when generalizing the observed results to men. Third, the questionnaire that was used to measure lifestyle self-efficacy is not yet validated. However, Cronbach's alpha is high implying that these questions can be asked together. Fourth, this study may be subdued to selection bias as participants could enroll themselves in the intervention. Healthcare professionals who enrolled may be already more concerned with their lifestyle or well-being, or are more attracted to the intervention. Interestingly, the non-response analysis showed that participants who did not complete all measurements, and thus potentially dropped out, did not differ on average, in terms of the outcomes, except for anthropometrics. Non-responders tended to have a higher weight, BMI and body fat percentage. It could be that non-responders dropped-out of the intervention because they needed more help than this lifestyle intervention and may have noticed less chances and became demotivated. For example because they perceived a lot of stress, experienced adverse events or were in an unfortunate socioeconomic position [50]. It would be interesting to study this phenomenon more in depth. Future studies could include examining this phenomenon for example by interviews. Unfortunately, we had no information about healthcare workers who enrolled but did not start with the intervention. Fifth, the intervention is designed to ultimately improve the quality of care by improving well-being of the healthcare workers. Quality of care was not measured and therefore we cannot elucidate whether the intervention led to changes in quality of care. When implemented at a larger scale it may be possible to measure effects on these indicators using designs such as (cluster) RCTs, difference-in-difference or stepped-wedge studies. Alternatively, quality of care also includes indicators such as from the quintuple aim and patient safety indicators [15]. These indicators could be measured quantitatively but are also valuable to obtain through using qualitive evaluations. Finally, we adjusted for several covariates but residual confounding might be present because of incompletely or unmeasured confounders.

Future practice and recommendations for research

Multicomponent lifestyle interventions based on the ASE-model, theory of planned behavior and motivational interviewing techniques may be important approaches to improve the lifestyle behavior and well-being of (healthcare) professionals. Indirectly, this may lead to reduced sickness absence or drop-out, fewer mistakes, better performance and higher productivity [27]. Therefore, these findings offer a starting point for hospital or healthcare organization policymakers aiming to improve the health and vitality of their workers and the quality of their care. More research, preferably with designs with a high internal validity and including quality indicators, such as (cluster) RCTs, difference-in-difference or stepped-wedge studies, and with larger populations can elucidate more about the potential impact of such intervention

programs. Furthermore, research into the mechanisms that underly the potential effectiveness is important. Mediation analysis could be used to detect underlying effective elements (e.g. certain components or aspects of the theoretical foundation) of these interventions. Process evaluations can shed light on the "black box" under which conditions the intervention may be effective or ineffective, for example due to the dose received and therefore future research should also invest in a thorough process evaluation. Important indicators for process evaluations include examining quantitative aspects such as the implementation, reach, dose given and dose received but qualitative investigation may also be important. This can be done by interviewing participants and providers of the intervention or by focus group discussions about their perception of the intervention and potential effects and their satisfaction/acceptance. It would be interesting to also include examining reasons for drop-out in a process evaluation.

Conclusion

This study provides promising results that multicomponent lifestyle intervention, such as the "Healthy and Vital" for healthcare professionals, have a positive short-term impact on lifestyle-related outcomes and well-being, including eating behavior, anthropometrics (weight, BMI, body fat percentage, waist circumference), self-efficacy and quality of life. These results are important for policymakers at hospitals or healthcare organizations aiming to improve the health of their workers and the quality of their care. We recommend future research to evaluate the "Healthy and Vital" and other multicomponent lifestyle interventions using designs higher in internal validity, such as (cluster) RCTs, difference-in-difference or stepped-wedge studies with a longer follow-up period.

Abbreviations

RdG	Reinier de Graaf Hospital
ASE-model	Attitude Self-Efficacy Model
BMI	Body Mass Index
SD	Standard Deviation
CBT	Cognitive Behavior Therapy
CI	Confidence Interval
RCT	Randomized Controlled Trial
PREMS	Patient reported experience measures
PROMS	Patient reported outcome measures

Supplementary Information

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Supplementary Material 1.

Supplementary Material 2.

Supplementary Material 3.

Supplementary Material 4.

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Authors' contributions

Mirte Boelens Formal analysis, Investigation, Writing- Original draft, Writing-review & editing. Sytian Mimpen-Haak Conceptualization, Methodology of the intervention design, Data curation, Writing-review & Editing, Project administration. Liset Elstgeest Conceptualization, Data Curation, Writing - Review & Editing. Dave Schweitzer Conceptualization, Supervision, Writing-Review & Editing, Project administration. Carina Hilders Writing- review & editing, Project administration. Jessica Kiefte-de Jong Formal analysis, Writing-Review & editing.

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Data availability

The data that support the findings of this study are available from Reinier de Graaf Hospital but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of Reinier de Graaf Hospital.

Declarations

Ethics approval and consent to participate

This study consisted of an analysis of data collected for quality improvement purposes and was carried out as a service evaluation. The Medical Ethical Committee Leiden Den Haag Delft (METC LDD) has declared that the Medical Research Involving Human Subjects Act does not apply for this study and issued a declaration of no objection on August 25th, 2022 (MEC-22-3034).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.
Participants of the service gave oral informed consent for participation and before starting with the lifestyle intervention. An opt-out informed consent procedure before the analysis was used for data utilization for research purposes with a two weeks response time.

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