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Effectiveness of *Total Worker Health*® Interventions

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Total Worker Health® is an integrated approach to safety, health, and well-being introduced by the National Institute for Occupational Safety and Health (NIOSH) in 2011 and refined in 2016. *Total Worker Health* (TWH) is defined as "policies, programs, and practices that integrate protection from work-related safety and health hazards with promotion of injury and illness prevention efforts to advance worker well-being" (NIOSH, n.d., para. 1). At its core, the TWH program aims to enhance worker well-being by informing the design of work and employment conditions in a way that will not only prioritize safety but also optimize physical and psychological outcomes. Although there are interventions focusing on occupational safety and health *and* well-being, the empirical evidence of such programs in the literature remains sparse (Anger et al., 2015; Feltner et al., 2016). The purposes of this chapter are to provide a systematic review of occupational safety, health, and well-being intervention research through April 2017 and to examine the effectiveness of those interventions.

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SELECTION OF STUDIES FOR ANALYSIS

An initial search for publications focused on self-identified TWH interventions or "integrated occupational safety and health *plus* well-being interventions" linked to the NIOSH list of issues relevant to the TWH program (Chapter 2, this volume; NIOSH, 2015a). Entering these phrases independently or in combination into PubMed, Scopus, and PsycINFO produced 51,227 citations. Given that the emergent literature pool was impractical to tackle, the search strategy was modified to focus specifically on the phrase "total worker health," which would provide directly relevant results; a search for "total worker health" resulted in 30 hits via PubMed, 451 in Google Scholar, and 22 in Scopus. PsycINFO provided surprisingly few, mostly overlapping hits. The six NIOSH-funded TWH Centers of Excellence were contacted to identify published and in press articles on intervention results. Other sources included the NIOSHTIC-2 database (NIOSH, 2015b) and the systematic reviews of the TWH program (Anger et al., 2015; Feltner et al., 2016).

Each of the titles, abstracts, or full articles was examined to identify studies that met four inclusion criteria. First, the intervention addressed (attempted to change) both traditional safety and health *and* well-being issues; although there would appear to be a clear distinction between safety and wellness or well-being targets, crosscutting targets (viz., stress, sleep, sitting) were judged to simultaneously address both. Second, there was a degree of integration between safety and health *and* well-being in the intervention program. Third, the research was conducted as a designed study, employing quasi-experimental or randomized designs. Fourth, publications were in English. Thirty-eight studies met the inclusion criteria. Seven studies identified *"Total Worker Health"* in the publication, six of which have been published by authors in TWH Centers of Excellence.

KEY FEATURES OF THE INTERVENTIONS REVIEWED

Key features were extracted from each article (Table 4.1): (a) industry sector based on the Standard Industrial Classifications (Occupational Safety and Health Administration, n.d.); (b) country where the intervention was conducted; (c) goal of the intervention; (d) intervention dose based on the time schedule and length, and delivery mode—live or in-person presentations, online or computer presentation, paper-based information, and introduction of equipment/environment; (e) intervention target—employee, supervisor, and manager; (f) degree of integration (see next)—high, medium, and low; (g) sample size (at baseline); and (h) study design.

Because integration between the *occupational safety and health* and *well-being* components within an intervention is a salient feature of the TWH program, the degree of integration was assessed in each study. Although there is no established definition of "integration," the Indicators of Integration (Sorensen et al., 2013; Williams et al., 2015) and NIOSH's Fundamentals of Total Worker Health Approaches (NIOSH, 2016a) provided guiding frameworks.

TABLE 4.1. Key Features of the TWH Interventions

Author (year); *Name of Intervention* (if so identified)	Intervention goal	Industry / Country	Dose / Mode	Integration target	Integration rating	*n*	Research design
Adeleke, Healy, Smith, Goode, & Clark (2017)	Reduce sitting	Public administration / Australia	12.9 w / E	E S M	M	137	Quasi—no C
Alkhajah et al. (2012)	Reduce sitting	Services / Australia	1 w, 3 m / E	E	M	32	Quasi—w/ C & Pretests
Bertera (1990)	Improve lifestyle	Manufacturing / U.S.	2 y / L P E	E	H	43,888	Quasi—w/ C & Pretests
Bøggild & Jeppesen (2001)	Enhance shift scheduling	Services / Denmark	6 m / L P E	E S	H	101	Quasi—w/ C & Pretests
Carr et al. (2016)[a]	Increase physical activity	Unspecified ("Company") / U.S.	16 w / L O E	E	L	54	RCT comparing 2 treatment groups, no C (w/ Pretest)
Caspi et al. (2013); *Be Well, Work Well*	Encourage safe patient handling, fitness, improve ergonomics	Services / U.S.	3 m / L E	E S M	H	374	Quasi—pre-post, no C
Cherniack et al. (2016); *HITEC 2*[a]	Improve safety and well-being using participatory approach	Public administration / U.S.	5 y / L P	E S M	H	326	Quasi—2 conditions; pre-post; no C

(*table continues*)

TABLE 4.1. (continued)

Author (year); *Name of intervention* (If so identified)	Intervention goal	Industry / Country	Dose / Mode	Integration target	Integration rating	*n*	Research design
Coffeng, Boot, et al. (2014); Coffeng, Hendriksen, et al. (2014); *Be Active & Relax: Vitality in Practice*	Reduce need for recovery, stress; increase physical activity	Finance / Netherlands	? / L O P E	E S	M	412	RCT—Factorial Design
Dalton & Harris (1991)	Integrate company-wide safety, industrial hygiene, primary care, health promotion	Other ("Telecommunications") / U.S.	1,460–1,825 d / L P	E S M	H	6,600	Quasi—Interrupted Time Series
Danquah, Kloster, Holtermann, Aadahl, Bauman, et al. (2017); *Take a Stand!*	Reduce sitting	Unspecified ("Offices") / Denmark	? / L O E	E	H	313	RCT—Pre-post test w/ C
Dennerlein et al. (2017)[a]	Increase safe patient handling equipment use	Services / U.S.	7 m / L E	E S M	H	1,832	Quasi—Pretests w/ C
Eriksen et al. (2002)	Manage stress, improve lifestyle	Public administration / Norway	120 h / L	E	L	860	RCT—Multiple treatments & C w/ pretest
Glass et al. (2016); *IPV and the Workplace*	Prevent IPV via supportive work environment	Public administration / U.S.	1 session / O	S	L	941	RCT—Pre-post test w/ C
Hammer et al. (2016); *Work, Family, and Health Study*	Improve work-life balance	Services / U.S.	9 h + / L O	E S M	M	1,524	RCT + Pre-post test w/ C

Hammer et al. (2015); *SHIP*[a]	Increase effective supervision, team effectiveness	Construction —— U.S.	5.83 h —— L O E	E S	H	264	RCT—pre-post test w/ C
Konradt, Schmook, Wilm, & Hertel, (2000); *Health Circles*	Increase stress and coping	Multiple industries —— Germany	15 h —— L	E	L	17	Quasi—pre-post test
Kurowski, Gore, Roberts, Richardson Kincaid, & Punnett (2017)	Increase safe patient handling equipment use	Services —— U.S.	2 y —— L E	E	H	several centers	Quasi—no C
Lin, Lin, Chen, & Lee (2017); *Sit Less, Walk More*	Increase physical activity, reduce sitting	Other ("Aerospace industry") —— Taiwan	12 w —— L P E	E	M	99	Quasi—Pretests w/ C
Maes, Verhoeven, Kittel, & Scholten, (1998); *Brabantia Project*	Participatory management-employee work improvement	Manufacturing —— Netherlands	3 y —— L P E	E S	H	264	Quasi—Pretests w/ C
Okechukwu, Krieger, Sorensen, Li, & Barbeau (2009); *Mass Built*	Reduce smoking	Construction —— U.S.	4 m —— L P E	E	M	1,213	RCT + Pre-post test w/ C
Olson et al. (2009); *SHIFT* pilot	Encourage weight loss; improve safety	Transportation —— U.S.	~ 8 h —— L O P	E	L	29	Quasi—Pre-post, no C
Olson, Thompson, et al. (2016); *COMPASS*[a]	Create peer support groups; improve safety, lifestyle	Services —— U.S.	30 h —— L P	E	H	149	RCT + Pre-post test w/ C

(table continues)

TABLE 4.1. (continued)

Author (year); *Name of intervention* (if so identified)	Intervention goal	Industry / Country	Dose / Mode	Integration target	Integration rating	*n*	Research design
Olson, Wipfli, et al. (2016) *SHIFT*	Encourage weight loss; improve safety	Transportation / U.S.	3.75 h + / L O P	E	L	452	RCT—Pre-post test w/ C
Olson et al. (2015); *COMPASS* pilot[a]	Create peer support groups; improve safety, lifestyle	Services / U.S.	6 m / L P	E	H	16	Quasi—Pre-post, no C
Peters & Carlson (1999)	Manage stress; improve lifestyle	Services / U.S.	7 h / L E	E	L	50	RCT + Pre-post test w/ C
Pronk, Katz, Lowry, & Payfer (2012)[a]; *Take-a-Stand Project*	Reduce sitting	Public administration / U.S.	4 w / E	E	M	34	Quasi—Interrupted Time Series
Ramey et al. (2016)	Manage stress; increase resiliency	Public administration / U.S.	2 sessions + 3 m / L O E	E	M	38	RCT—Pre-post test w/ C
Rohlman et al. (2016)[a]; *PUSH*	Educate on worker rights, communication, lifestyle	Public administration / U.S.	1 h / O	E	L	255	RCT—Pre-post test w/ C
Snetselaar et al. (2016); *Be Hipp*	Manage stress; improve lifestyle, ergonomics	Multiple industries / U.S.	3 y / L	E S M	L	280	RCT—Pre-post test w/ C
Sorensen et al. (2007)[a]; *Tools for Health*	Reduce smoking; increase fruit/ vegetable intake	Construction / U.S.	3 m (?) / L P	E	L	582	RCT—Pre-post test w/ C

Sorensen et al. (2005)[a]; *Healthy Directions-Small Business*	Reduce smoking, hazardous exposure; improve lifestyle	Manufacturing U.S.	18 sessions L O	E S M	H	974	RCT—Pre-post test w/ C
Sorensen et al. (2016)[a]; *Be Well, Work Well*	Improve ergonomics, lifestyle	Services U.S.	? L O P E	E S	H	452	RCT—Pre-post test w/ C
Sorensen et al. (1998)[a]; *WellWorks Study*	Reduce smoking, hazardous exposure	Manufacturing U.S.	? L P	E	H	2,386	RCT—Pre-post test w/ C
Sorensen et al. (2003)[a]; *WellWorks2*	Reduce smoking, hazardous exposure	Manufacturing U.S.	? L E	E S M	H	9,019	RCT—Alternative-treatments design w/ Pretest; no C
Sorensen et al. (2010)[a]; *Gear Up for Health Study*	Reduce smoking; encourage weight loss	Transportation U.S.	5 sessions L	E	L	215	Quasi—no C
Tsutsumi et al. (2009)	Improve workplace via participatory intervention	Manufacturing Japan	48 w L	E S M	H	97	RCT—Pre-post test w/ C
Tveito & Eriksen (2009); *Integrated Health Programme*	Manage stress	Services Norway	123 h L	E	M	40	RCT—Pre-post test w/ C
von Thiele Schwarz et al. (2015)	Integrate health protection and health promotion with continuous improvement	Services Sweden	1.5 y L	E S M	H	202	RCT—Pre-post test w/ C

Note. Intervention names are provided where applicable. Dose (+ = added components, ? = time not specified; h = hours, d = days, w = weeks, m = months, y = years); Mode (L = live, O = online/computer, P = paper, E = equipment/environment), Integration Target (E = employees, S = supervisor, M = managers); Integration Rating (H = high, M = medium, L = low); Research Design (RCT = randomized controlled trial; Quasi = quasi-experimental; w/ = with; C = control); IPV = intimate partner violence.
[a]Interventions from National Institute for Occupational Safety and Health–funded TWH Centers.

We examined whether each intervention reflected three key factors: it addressed occupational safety and health *plus* well-being at the organizational level (e.g., included workplace policy change) and at the individual level (e.g., included lifestyle programs, safety trainings) and had leadership engagement (i.e., senior leaders were involved in the development and/or implementation of the intervention). An intervention was rated *high* if all factors were present and low if only one of the three factors was present. In most cases, the extent of integration was not made explicit in the publication, leaving us to infer from the description of the methods.

Intervention Goal

The intervention goals were diverse. Reducing sitting/increasing activity at work and stress management were the goals of four interventions, and the introduction of participatory interventions that involved both management and labor representatives was also a goal of four others.

Location and Industries

Most of the interventions occurred in the United States (26). The largest number of interventions were implemented in the area of services ($n = 12$), followed by public administration ($n = 7$), manufacturing ($n = 6$), construction ($n = 3$), transportation ($n = 3$), and finance ($n = 1$). Other studies fell into the "other" category ($n = 2$), two studies employed multiple industries, and another two studies did not specify a type of industry.

Intervention Dose and Mode of Delivery

The intervention dose—the specific duration or number of sessions—was difficult to extract from many of the publications as noted by a question mark in the body of Table 4.1. Of those identified, the range was from 1 hour (Rohlman, Parish, Elliot, Hanson, & Perrin, 2016) to (periodic activities over) 5 years (Cherniack et al., 2016). Examples of shorter intervention duration were 1 hour (Rohlman et al., 2016), 2.5 hours (Caspi et al., 2013), 4 to 8 hours (Olson, Anger, Elliot, Wipfli, & Gray, 2009; Olson, Wipfli, et al., 2016), or 12 hours (Snetselaar et al., 2016). Longer duration interventions included those of Sorensen et al. (2005) with a dose of 18 sessions and Olson, Thompson, et al. (2016) with a dose of 30 hours. Tveito and Eriksen (2009) included aerobic exercise and training for 123 hours over 9.03 months, and the Eriksen et al. (2002) intervention provided a dose of 120 hours over 12 weeks (Table 4.1).

The majority of studies ($n = 31$) delivered the intervention live (in person). Interventions delivered via online platforms, paper, and/or the work environment were often used in conjunction with in-person contact.

Intervention Target

One intervention targeted supervisors exclusively (Glass, Hanson, Laharnar, Anger, & Perrin, 2016). The other 37 were aimed at employees combined with managers and supervisors.

Degree of Integration

Contrary to many traditional wellness and safety efforts where the burden of responsibility lies on the individual employee, the TWH program emphasizes high integration between occupational safety and health *and* the well-being components of an intervention. Many of the studies in our review (n = 19) were judged as having a high degree of integration. That is, they included an organization-level focus and individual-level change and they engaged leadership. Eight studies were rated as having medium integration, and 11 studies were rated as having a low degree of integration. Only two of the studies compared an integrated TWH program to either a safety-only (Carr et al., 2016) or a health-promotion-only (Sorensen et al., 2003) program, and none compared an integrated program to safety-only *and* well-being-only programs. Studies measured the level of integration between health protection and health promotion (von Thiele Schwarz, Augustsson, Hasson, & Stenfors-Hayes, 2015) and measured employee understanding of the link between work and health (Coffeng, Boot, et al., 2014). Overall, although there are many types of employment structures (consider home care workers who work alone in a person's apartment or home), our assessment of integration was tailored to organizations with traditional hierarchical and policy structures.

Research Design and Sample Size

The designs of the majority of the included studies were conducted as randomized trials (n = 21); the others employed quasi-experimental designs. The intervention sample size ranged from 16 to 43,888; the mean sample size was 2,014, and the median was 264 participants.

INTERVENTION EFFECTS

The outcomes of studies designed as randomized trials (n = 21) are listed in Table 4.2. Both statistically significant and nonsignificant effects are listed to identify outcomes not changed by the interventions as well as those that were changed. Where available, secondary outcomes are identified, and when the distinction was not explicit in the publication, all outcomes are categorized as primary. In three studies, proximal outcomes were identified. Intervention effect sizes are included if listed in the article or if sufficient data were provided for a calculation. Six articles included measures of effect size.

TABLE 4.2. Significant and Nonsignificant Intervention Effects

Study	Significant effects	Nonsignificant effects
Carr et al. (2016)	Primary outcomes: % work time in light intensity physical activity	Primary outcomes: total occupational physical activity, % work time sedentary, % work time in moderate intensity physical activity, % work time in vigorous intensity physical activity
Coffeng, Boot, et al. (2014); Coffeng, Hendriksen, et al. (2014); *Be Active & Relax: Vitality in Practice*	Primary outcomes: Significant Ix effects for some Ix conditions on task performance, contextual performance, and work engagement (absorption and dedication) at some follow-up assessment wave (6 m or 12 m) Secondary outcomes: Significant Ix effects for some Ix conditions on work-related stress exhaustion, small breaks at work, physical activity stair climbing at work, sedentary behavior at work at some follow-up assessment wave (6 m or 12 m)	Primary outcomes: Need for recovery (6 m and 12 m follow-ups), nonsignificant Ix effects for some Ix conditions on presenteeism (absolute, relative and absenteeism), work performance (task performance, contextual performance, and counterproductive work behavior), work engagement (absorption and dedication) at some follow-up assessment wave (6 m or 12 m) Secondary outcomes: Nonsignificant Ix effects for some Ix conditions on work-related stress exhaustion, detachment at work, detachment after work, relaxation at work, relaxation after work, small breaks at work, physical activity stair climbing at work, active commuting, leisure activities, sport activities, light physical activity, moderate physical activity, vigorous physical activity, sedentary behavior at work at some follow-up assessment wave (6 m or 12 m)
Danquah, Kloster, Holtermann, Aadahl, Bauman, et al. (2017); Danquah, Kloster, Holtermann, Aadahl, & Tolstrup (2017); *Take a Stand!*	Primary outcomes: Neck/shoulder pain (3 m follow-up)	Primary outcomes: Neck/shoulder pain (1 m follow-up), back pain (1 m and 3 m follow-ups), extremity pain (1 m and 3 m follow-ups), total pain score (1 m and 3 m follow-ups)

Eriksen et al. (2002)	Primary outcomes: Various subjective effects that depended on the particular intervention condition on health, work environment, physical fitness, work situation, muscle pain, stress, health maintenance	Primary outcomes: Subjective health complaints of musculoskeletal, pseudoneurological, gastrointestinal, allergy, and flu, job stress (domains of communication, leadership, relocation, workload, sick leave)
Glass et al. (2016); *IPV and the Workplace*	Primary outcomes: Workplace climate toward domestic violence Proximal outcomes: Intimate partner violence training knowledge	Primary outcomes: Providing incentives did not significantly moderate the Ix effect on workplace climate toward domestic violence
Hammer et al. (2016); *Work, Family, & Health Study*	Primary outcomes: Safety compliance (6 m follow-up, $d = 0.12$), organizational citizenship behaviors (12 m follow-up, $d = 0.16$), some significant moderated Ix effects were obtained for at least one follow-up period for the primary outcomes as a function of baseline Family Supportive Supervisor Behavior, perceived work–family climate, and control over work time values. Proximal outcomes: Control over work time (6 m follow-up, $d = -0.16$ [unexpected direction])	Primary outcomes: Safety compliance (12 m follow-up, $d = 0.08$), Organizational Citizenship Behaviors (6 m follow-up, $d = 0.09$), some non-significant moderated Ix effects were obtained for at least one follow-up period for the primary outcomes as a function of baseline Family Supportive Supervisor Behavior, perceived work–family climate, and control over work time values. Proximal outcomes: Family Supportive Supervisor Behaviors (6 m follow-up, $d = 0.08$, 12 m follow-up, $d = 0.10$), control over work time (12 m follow-up, $d = -0.11$), work-to-family conflict (6 m follow-up, $d = 0.03$, 12 m follow-up, $d = 0.06$), family-to-work conflict (6 m follow-up, $d = -0.04$, 12 m follow-up, $d = -0.02$)
Hammer et al. (2015); *SHIP*	Primary outcomes: Blood pressure ($\Delta R^2 = .015$)	Primary outcomes: Physical health ($\Delta R^2 < .001$), safety compliance ($\Delta R^2 = .001$), safety participation ($\Delta R^2 = .014$)
Okechukwu et al. (2009); *Mass Built*	Primary Outcome: Quit rates among smokers (30 days postintervention) Secondary Outcomes: Decrease in daily cigarette smoking of at least half a pack (6 m postintervention)	Primary Outcome: Quit rates among smokers (6 m postintervention) Secondary Outcomes: Smoking cessation attempts lasting more than 1 day, decisional balance that supports smoking cessation, number of days smoking

(*table continues*)

TABLE 4.2. (continued)

Study	Significant effects	Nonsignificant effects
Olson, Thompson, et al. (2016); *COMPASS*	Primary outcomes: Experienced community of practice (6 m follow-up, $d = 0.36$, 12 m follow-up, $d = 0.37$); talked about improving unsafe conditions (12 m follow-up, $d = 0.84$); corrected slip, trip, or fall hazards (12 m follow-up, $d = 0.45$); used new tool or techniques for moving objects (6 m follow-up, $d = 0.65$); used new tool or techniques for housecleaning (6 m follow-up, $d = 0.51$, 12 m follow-up, $d = 0.64$); fruit and vegetable intake (12 m follow-up, $d = 0.31$); meals brought from home (12 m follow-up, $d =$ <minus>0.46 [unexpected direction])	Primary outcomes: Talked about improving unsafe conditions (6 m follow-up, $d = 0.34$); corrected slip, trip, or fall hazards (6 m follow-up, $d = 0.13$); corrected other hazards (6 m follow-up, $d = -0.05$, 12 m follow-up, $d = 0.16$); used new tool or techniques for moving objects (12 m follow-up, $d = 0.17$); fruit and vegetable intake (6 m follow-up, $d = 0.12$); sugary snack intake (6 m follow-up, $d = -0.28$, 12 m follow-up, $d = -0.03$); sugary drink intake (6 m follow-up, $d = 0.00$, 12 m follow-up, $d = 0.05$); fast-food intake (6 m follow-up, $d = 0.00$, 12 m follow-up, $d = 0.06$); meals brought from home (6 m follow-up, $d = -0.13$); health physical activity (6 m follow-up, $d = 0.09$, 12 m follow-up, $d = 0.18$); SF-12 physical health composite (6 m follow-up, $d = -0.06$, 12 m follow-up, $d = -0.18$); SF-12 mental health composite (6 m follow-up, $d = -0.03$, 12 m follow-up, $d = 0.03$)
	Secondary outcomes: Client corrected slip, trip, or fall hazards (12 m follow-up, $d = 0.51$); client corrected other hazards (6 m follow-up, $d = .82$, 12 m follow-up, $d = 1.01$); client noted using new tool or technique for housecleaning (6 m follow-up, $d = 0.69$)	Secondary outcomes: Sleep quality; perceived stress; musculoskeletal pain and discomfort; functional impairment with activities of daily living; work-related injuries and lost work time attributable to illness or injury; blood pressure; blood cholesterol; triglycerides; glucose; body mass index; hand strength; hamstring flexibility; walk test; client interpersonal conflict with home care worker (6 m follow-up, $d = -0.13$, 12 m follow-up, $d = -0.18$); client satisfaction with home care worker (6 m follow-up, $d = 0.08$, 12 m follow-up, $d = 0.06$); client talked about improving unsafe conditions (6 m follow-up, $d = -0.06$, 12 m follow-up, $d = 0.34$); client corrected slip, trip, or fall hazards (6 m follow-up, $d = 0.23$); client noted using new tool or technique for moving objects or self (6 m follow-up, $d = 0.39$, 12 m follow-up, $d = 0.44$); client noted using new tool or technique for housecleaning (12 m follow-up, $d = 0.33$)

Olson, Wipfli, et al. (2016); *SHIFT*	Primary outcomes: Body weight ($d = -0.13$), body mass index ($d = -0.14$), daily fruit/vegetable intake ($d = 0.33$), physical activity ($d = 0.34$) Secondary outcomes: Waist circumference ($d = -0.11$), % body fat ($d = -0.23$)	Primary outcomes: Energy usage from fat, sugary snack intake, sugary drink intake, fast food intake Secondary outcomes: Sleep quality, sleep duration, waist-to-hip ratio, systolic BP, diastolic BP, total cholesterol (plus HDL and LDL), triglycerides, blood glucose, driving safety incidents, days missed for illness or injury
Peters & Carlson (1999)	Primary Outcomes (at 3 m posttreatment): % overweight, exercise amount, health behavior changes, HSE general, HSE for exercise, HSE for stress management, curiosity, social support for health, positive environment for health	Primary Outcomes (at 3 m posttreatment): Systolic blood pressure, diastolic blood pressure, cholesterol, risk age, cigarettes smoked, HSE for nutrition, HSE for responsible practices, anxiety, anger, depression, intention to change for health, access to health care satisfaction, job satisfaction, health locus of control, injuries and absenteeism
Rohlman et al. (2016); *PUSH*	Primary outcomes: Safety behaviors ($d = -0.36$), health attitudes ($d = -0.37$), Safety attitudes ($d = -0.37$) Proximal outcomes: Safety and health training knowledge ($d = 0.40$)	Primary outcomes: Health behaviors ($d = -0.15$) Proximal outcomes: Nonsafety and health training knowledge ($d = -0.21$)
Snetselaar et al. (2016); *Be Hipp*	Primary outcomes: None	Primary outcomes: Absenteeism
Sorensen et al. (2007); *Tools for Health*	Primary outcomes: Smoking cessation (7 days or more), any tobacco use cessation, quit attempts, daily fruit and vegetable consumption	Primary outcomes: None reported
Sorensen et al. (2005); *Healthy Directions*	Primary outcomes: Multivitamin use, some significant moderated Ix effects obtained for the primary outcomes as a function of gender, race/ethnicity, occupational class, and education subgroup	Primary outcomes: Fruit and vegetable consumption, red meat consumption, physical activity, some nonsignificant moderated Ix effects were obtained for the primary outcomes as a function of gender, race/ethnicity, occupational class, and education subgroup

(*table continues*)

TABLE 4.2. (continued)

Study	Significant effects	Nonsignificant effects
Sorensen et al. (2016); *Be Well, Work Well*	Primary outcomes: None Proximal outcomes: Safety practices (unexpected direction)	Primary outcomes: Pain severity, any pain, work interference, fruit/vegetable intake, sugary snacks intake, sugary drinks intake, fast food intake, physical activity, minutes walking weekly, daily minutes sitting, sleep deficiency Proximal outcomes: Ergonomic practices, supervisor support, coworker support, meal break frequency
Sorensen et al. (1998); *WellWorks*	Primary outcomes: % calories consumed as fat, fruit and vegetable intake, moderated Ix effect on fiber consumption as a function of job category	Primary outcomes: Smoking cessation, fiber consumption
Sorensen et al. (2003); *WellWorks2*	Primary outcomes: None	Primary outcomes: Smoking prevalence, fruit and vegetable intake
Tsutsumi et al. (2009)	Primary outcomes: Health and work performance	Primary outcomes: General health
Tveito & Eriksen (2009); *Integrated Health Programme*	Primary outcomes: Neck pain Secondary outcomes: Subjective improvements in health, work enviro n-ment, physical fitness, work situation, muscle pain, stress management, health maintenance	Primary outcomes: Sick leave; subjective health complaints in allergy, flu, musculoskeletal, pseudoneurology, and gastrointestinal domains Secondary outcomes: Coping, job stress, effort reward imbalance, demands, control, physical functioning, role physical, general health, bodily pain, vitality, social functioning, role emotional, mental health
von Thiele Schwarz et al. (2015)	Primary outcomes: None Proximal outcomes: Health promotion (η^2 = .06), integration (η^2 = .09) and Kaizen (η^2 = .04)	Primary outcomes: Workability (η^2 = .03), self-rated health (η^2 < .01), productivity (η^2 = .03), sickness absence duration, sickness absence frequency

Note. *d*, ΔR^2, and η^2 are effect size indicators. Ix = intervention effects; m = months; SF-12 = 12-Item Short Form Health Survey; BP = blood pressure; HDL = high-density lipoprotein; LDL = low-density lipoprotein; HSE = health self-efficacy.

Most studies do not report effect size, a significant gap in reporting. The attempt to distinguish occupational safety/health from well-being outcomes was limited given the lack of consistency in reporting. We recommend reporting standardized effect size as a practical indicator of the magnitude of intervention impact. Alternatively, researchers could develop "minimal clinically important differences" for unstandardized effects and discuss whether the intervention effects exceed these differences.

HIERARCHY OF CONTROLS APPLIED TO THE TWH PROGRAM

The intervention methods in the 38 studies can be described in relation to the Hierarchy of Controls as applied to the TWH approach (NIOSH, 2016b) in Table 4.3. NIOSH recommends that efforts to advance occupational safety and health *plus* well-being employ the five levels of the hierarchy in order of priority, with *eliminate* being the highest priority and *encourage* being the lowest:

- *Eliminate* negative working conditions and barriers to safety, health, and well-being.
- *Substitute* safer and healthier workplace policies, work processes, and practices.
- *Redesign* the work environment to enhance working conditions and improve safety, health, and well-being.
- *Educate* all employees and provide resources for improved knowledge.
- *Encourage* or reinforce adoption of safe and healthy practices.

The majority of studies in this review employed the *educate* approach to implement TWH, followed by *encourage* ($n = 30$), *redesign* ($n = 20$), and *substitute* ($n = 8$); only four interventions employed the strategy to *eliminate* a problem, the highest priority method of control. Three studies employed all five levels of control, and three others employed only one; most studies used two ($n = 17$) or three ($n = 13$) levels of control.

CONCLUSION

We find that there has been an increase in efforts to tackle health and safety outcomes within the workplace since earlier reviews (Anger et al., 2015; Feltner et al., 2016), although the inclusion criteria varied in these reviews. As of 2013, 17 TWH interventions were identified by Anger et al. (2015), whose inclusion criteria closely resembled those used here. Our review found that number to be 38 as of April 2017. Interventions most often were implemented in the healthcare industry; they ranged in duration from 1 hour (Rohlman et al., 2016) to periodically over 5 years (Cherniack et al., 2016), and most were delivered in person, targeted employees and supervisors, and were successful in addressing a wide range of occupational safety and health *and* well-being outcomes.

TABLE 4.3. Hierarchy of Controls Applied to the TWH Program

Study	Eliminate	Substitute	Redesign	Educate	Encourage
Adeleke et al. (2017)			Added sit-stand workstations		
Alkhajah et al. (2012)			Added sit-stand workstations	Oral instruction in workstation use: written ergonomic instructions on sitting, standing posture	
Bertera (1990)		Heart healthy options replaced cafeteria, vending machine options		Health Risk Appraisal with interpretation by medical personnel. Training for program coordination, implementation. Individual training in stress management, dental health, weight control, fitness, healthy back, blood pressure, nutrition, smoking cessation. Blood pressure and scales made available. Safety meetings.	Challenges and incentive programs to stimulate fitness, weight control, smoking cessation; individual counseling; program implementation committee
Bøggild & Jeppesen (2001)			Incorporated principles of shift scheduling and allowed workers to select beneficial shift schedules	Education on shift schedules, shift work problems, options for changing schedules	
Carr et al. (2016)			Added seated elliptical machine with daily pedaling tracker and feedback	Consultation on optimizing workstation ergonomics	E-mail prompts for rest breaks, posture variation, physical activity, work environment changes, reducing work stress

Caspi et al. (2013); *Be Well, Work Well*Pilot			Safety audits led to improved ergonomics	One-on-one safe patient handling training	Posters to encourage physical fitness
Cherniack et al. (2016)		Added healthy vending choices	Developed plans to place noise-damping panels, replace headphones. New cleaning schedules; reduced temperature variability.	Participatory problem solving to improve fitness for duty; posters and educational materials on healthy eating	Participatory process designed to engage people across the organization and encourage change. Program viewed as a success if it progresses on a reliable schedule; implementation not required.
Coffeng, Boot, et al. (2014); Coffeng, Hendriksen, et al. (2014) *Be Active & Relax: Vitality in Practice*			"Vitality in Practice" zones for relaxation, background noise reduction, standing desks and meetings, recreation	Motivational interviews provided education	Group motivational interviewing to promote recovery; supported by social media platform
Dalton & Harris (1991)	Cigarette vending machines removed; smoking prohibited in company buildings and vehicles	Targets for accident frequency. Self-funded insurance. Healthy foods in cafeteria, vending machines.	Organizational surveys, participant-directed task realignment, job redesign, safety, quality improvements. Medically related disability managed.	Communications of programs, successes through newspaper, newsletters, videos, media; presentations to management on organizational stress management techniques	Divisional competition to improve in safety; incentives to join HMO; on-site primary care: screening, chronic disease monitoring, counseling

(table continues)

TABLE 4.3. (continued)

Study	Eliminate	Substitute	Redesign	Educate	Encourage
Danquah, Kloster, Holtermann, Aadahl, Bauman, et al. (2017); Danquah, Kloster, Holtermann, Aadahl, & Tolstrup (2017); *Take a Stand!*			Added standing tables for meetings; structured walking meetings; walking routes	Lecture on sedentary behavior and health	Health ambassadors for social support; manager commitment to act as role models; individual goal setting; e-mails and texts
Dennerlein et al. (2017)			Added safe patient equipment, building infrastructure. Process for maintaining equipment. Scheduled training for staff attendance. Began patient mobility needs assessment and care plan.	Instructions at bedside and on portable equipment; training on safe patient handling; new employees trained by champions (given added training, mentoring); patient education materials communicated program goals, benefits	Internal marketing campaign on safe patient handling
Eriksen et al. (2002)		New work practices on lifting, static work, repetitive motions		Integrated health program on nutrition, exercise pain, stress and coping; stress management	Aerobic dancing, physical exercise program for muscle strength, flexibility, relaxation and pain reduction

Glass et al. (2016); *IPV and the Workplace*			Supervisor training on Intimate Partner Violence, Family and Medical Leave Act	
Hammer et al. (2016); *Work, Family, & Health Study*			Supervisor training on how to support employees' personal and family lives. Behavior tracking of family-supportive supervisor behaviors.	
Hammer et al. (2015); *SHIP*		Teams developed plans to improve team workflow and processes	Supervisor training and behavior tracking on supportive supervisory behaviors, schedule flexibility to reduce work–life stress and prioritize safety; team effectiveness education in groups	30-, 60-, and 90-day check-ins where supervisors assessed progress with team effectiveness.
Konradt et al. (2000); *Health Circles*			5-hour group Health Circle sessions with a facilitator: information on stress coping strategies, and selection of strategies	Health Circle sessions: held informal and facilitated discussions to enhance motivation
Kurowski et al. (2017)	Follow-up meetings about use of resident transfer equipment	Added mechanical lifts, lifting protocols	Training, demonstrations of use and maintenance of transfer equipment; competency tests	
Lin et al. (2017); *Sit Less, Walk More*			Monthly newsletter providing health education	Self-monitoring, goal setting; pedometer challenge; prompts to increase activity, reduce sitting, walk route use; encouraged walk breaks

(*table continues*)

TABLE 4.3. (continued)

Study	Eliminate	Substitute	Redesign	Educate	Encourage
Maes et al. (1998); *Brabantia Project*	No-smoking policy in cafeteria		Reorganization of production by enhancing decision latitude, job autonomy, task rotation. Trained leaders, employees on ergonomics. Created on-site exercise facility.	Health & safety education; trained management in social skills, leadership	Partly paid exercise and health education time; health fair; health exhibition; advertising of program (posters, video); incentives to participate in health initiatives
Okechukwu et al. (2009); *Mass Built*				Two 1-hour classes on effects of tobacco, toxic exposures at work that synergized with tobacco smoke	Posters, written materials supporting tobacco cessation; tobacco counseling, nicotine replacement kit; quit-kit
Olson et al. (2009); SHIFT *Pilot*				Computer-based training and website with tailored information (sleep, body weight, occupational safety) and knowledge tests. Assessment to set weight loss goals. Motivational interviews provided education.	Weight loss and safety driving competition; behavioral self-monitoring; social interaction encouraged within teams; company communication prompts; biweekly individual and social comparison feedback; "certification" for meeting completion goals; cash incentives; motivational interviewing

Olson, Thompson, et al. (2016); *COMPASS*; Olson et al. (2015); *Pilot*		Scripted, peer-led meetings on occupational safety, health, well-being, communication	Individual and team goal-setting, behavioral self-monitoring emphasizing structured social support
Olson, Wipfli, et al. (2016); *SHIFT*		Computer-based training and website with tailored information (sleep, weight, occupational safety); knowledge tests. Interviews provided education. Assessment to set weight loss goals.	Weight loss competition with behavioral self-monitoring; motivational interviewing; "certification" for meeting completion goals; and cash incentives
Peters & Carlson (1999)		Professional Health Risk Assessment. Education on stress, stress management, exercise, sleep, smoking, health behaviors, lifestyle.	Behavioral self-contracting, goal setting, self-monitoring with results viewed in ongoing small group meetings
Pronk et al. (2012); *Take-a-Stand*	Added sit-stand devices on desks		3/day random text messages to ask if participants were sitting, standing, or walking
Ramey et al. (2016)		Educational class and "telementoring" on stress management, resiliency, physiological impact	In-field practice of learned skills with biofeedback
Rohlman et al. (2016); *PUSH*		Web-based training on workplace safety, health promotion, communication	

(*table continues*)

TABLE 4.3. (continued)

Study	Eliminate	Substitute	Redesign	Educate	Encourage
Snetselaar et al. (2016); *Be Hipp*				Monthly education sessions on nutrition, physical activity, stress management, and ergonomics	Used self-determination principles, group processes to motivate healthy lifestyle choices; modeled healthy food choices
Sorensen et al. (2007); *Tools for Health*				12–15 tip sheets on tobacco, nutrition, nature of laborers' work. Interviews provided education.	One-on-one motivational interviews (4) to encourage change
Sorensen et al. (2005); *Healthy Directions*	Created smoke-free workplace policies	Provided healthy food options at company meetings	Industrial hygiene consult led to systems-oriented approaches to occupational health	Tabletop displays and demonstrations	Smoking cessation program; signs to help workers meet physical activity guidelines. Health fairs.
Sorensen et al. (2016); *Be Well, Work Well*			Ergonomic walkthrough and work organization assessment with feedback to nurse managers; followed by up to 4 consultations with nurse managers on action plans	Kickoff health event; safe patient handling training. Healthy eating session (Eat Well). Presentation and conversation with sleep expert; ergonomic talks and individual assistance on safe patient handling, equipment and workstation setup; slip, trip, fall prevention; outside work activities. 10-week hospital nutrition and fitness program.	Pedometer challenge, competition among units to be physically active. Goal setting, health coaching (Plan Well). Mutual support of health and safety goals (Together We Are Well). Access to fitness center/personal training/nutritionist; telephone health coaching sessions on diet, physical activity, sleep hygiene, ergonomics. Social media page.

Sorensen et al. (1998); *WellWorks*	Engineering controls (e.g., ventilation systems) to reduce hazardous exposures. Protective equipment.	Safer chemicals replaced potential carcinogens. Include/substitute health food options in cafeteria, vending machines.	Tobacco control policies. Job redesign, rotations, administrative changes to minimize exposures. Industrial hygiene walk-through assessment and recommendations.	Nutritionist provided new recipes, suggested healthier foods; training program for food service manager, staff; opportunities to meet with nutritionist. Large- and small-group discussions to practice reviewing Material Safety Data Sheets, food labels. Activities for workers at all stages of readiness for change.	Workers involved in program planning and implementation. Management actions to communicate employer commitment to employee health. Promotions (e.g., posters, health fairs, brochures, self-assessments with feedback); quit-smoking contests.
Sorensen et al. (2003); LaMontagne et al. (2004); *WellWorks 2*		Industrial hygiene walk-through assessments with recommendations for reducing exposures		Self-assessment with feedback. Self-help activities, demonstrations.	Encouraged management to change policies, contests, practices, procedures on industrial hygiene, health promotion, occupational hazards. Behavior change tactics targeted smoking, fruits and vegetables (set goals, group discussions).
Sorensen et al. (2010); *Gear Up For Health*				Telephone counseling sessions with individualized feedback. Educational materials.	Individual counseling on work environment factors; nicotine replacement therapy, social context of work. Weekly meetings encouraged access to health counselors.

(table continues)

TABLE 4.3. (continued)

Study	Eliminate	Substitute	Redesign	Educate	Encourage
Tsutsumi et al. (2009)			Work station redesign, material storage, handling, clean up; use of appropriate tools, regular machine maintenance	Trained facilitators; supervisor education on positive mental health, improving work environment. Workshops. Improvements checklist.	Workers involved in redesign plans; researchers encouraged workers to sustain autonomous activities for workplace improvement
Tveito & Eriksen (2009); *Integrated Health Programme*			Practical examination of workplace: members contributed experiences on organization and job coping. Physical exercise.	Health information; stress management training	
von Thiele Schwarz et al. (2015)			(Kaizen) Practices to integrate health promotion and protection with production, quality	Train-the-trainer to facilitate program. Coaching would have provided education.	Coaching

Note. HMO = health maintenance organization.

Important to note, 21 of the 38 studies identified here were randomized trials (59%), the strongest research design. By contrast, the earlier review by Anger et al. reported that nine of the 17 TWH interventions (53%) were randomized controlled trials. Thus, strong designs continue to be employed in this emerging field of study.

The highest priority method for implementing the TWH program in industry is to eliminate barriers or negative working conditions, but this approach was used in only four of the 38 interventions. Rather, education and encouraging change are the most popular approaches. Perhaps a combination of controls is preferable; providing TWH education and encouraging its use is certainly valuable once an organization has eliminated the barriers and negative conditions. The majority of studies in this review employed *education* ($n = 34$) when implementing TWH, many paired with *encouragement* strategies ($n = 30$). In many cases, *redesign* ($n = 20$) and *substitution* ($n = 7$) were selected as strategies. Three studies employed all five levels of control.

Although there are strengths in the emerging TWH intervention literature, the gaps are significant. As noted earlier, there is a lack of effect sizes reported in the TWH literature. In their systematic reviews of the TWH literature, both Anger et al. (2015) and Feltner et al. (2016) urged researchers to use randomized controlled designs and report intervention effect sizes, which would facilitate meta-analysis studies of the TWH research. Another gap is that integration, a defining concept of the TWH approach, is rarely addressed in published studies. Integration of safety and health, and well-being, must be further developed as a construct, drawing clear operational definitions and indicators to guide future intervention efforts and to provide a basis for evaluating this basic TWH concept. Similarly, no study has individually examined the components of the TWH approach while testing their integration against a control condition. Thus, the basic principles underlying the TWH approach have not yet been examined with studies designed to evaluate the effectiveness of integrated safety, health, and well-being interventions. Nonetheless, this chapter provides a summary of the growing evidence base to support the effectiveness of TWH interventions, be they integrated or not, for improving safety, health, and well-being. The greatest gap in the TWH literature is the lack of factorial research studies testing the effectiveness of integrated versus independent applications of safety, health, and well-being intervention components.

Overall, despite the caveats just noted, our review identified 21 randomized trials showing positive outcomes, suggesting that TWH interventions can be effective in improving workplace outcomes in safety, health, and well-being. Future intervention research can be expected to offer broad-based and meaningful TWH solutions for improving worker safety, health, and well-being.

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