Walking Improves Sleep in Individuals With Cancer: A Meta-Analysis of Randomized, Controlled Trials

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Purpose/Objectives: To evaluate the effectiveness of walking exercise on sleep in people with cancer.

Data Sources: Databases searched included China Knowledge Resource Integrated Database, CINAHL®, Cochrane Central Register of Controlled Trials, EMBASE, PsycINFO®, PubMed, Wanfang Data, and Web of Science.

Data Synthesis: Nine randomized, controlled trials involving 599 patients were included. Most of the studies used moderate-intensity walking exercise. Overall, walking exercise significantly improved sleep in people with cancer (Hedges' g = –0.52). Moderator analyses showed that walking exercise alone and walking exercise combined with other forms of interventions yielded comparable effects on sleep improvement, and that the effect size did not differ among participants who were at different stages of cancer. The effect sizes for studies involving individuals with breast cancer and for studies including individuals with other types of cancer were similar.

Conclusions: Moderate-intensity walking exercise is effective in improving sleep in individuals with cancer.

Implications for Nursing: The authors' findings support the inclusion of walking exercise into the multimodal approaches to managing sleep in people with cancer. Healthcare providers must convey the benefits of walking exercise to individuals with cancer who are suffering from sleep problems.

Key Words: cancer; meta-analysis; sleep; walking exercise

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Early cancer diagnosis and treatment programs can prolong the lives of individuals with cancer. However, disturbed sleep is common among people with cancer, and many frequently report experiencing daily sleep disturbance following primary treatment (Davidson, MacLean, Brundage, & Schulze, 2002; Mercadante, Girelli, & Casuccio, 2004; Sela, Watanabe, & Nekolaichuk, 2005). Disturbed sleep may affect mental health, physical functioning, and health-related quality of life (Koopman et al., 2002; Le Guen et al., 2007; Romito et al., 2014).

Pharmacologic treatments and cognitive behavioral therapy for insomnia (CBT-I) are commonly used to treat sleep problems in survivors (Espie et al., 2008; Savard, Simard, Ivers, & Morin, 2005; Vena, Parker, Cunningham, Clark, & McMillan, 2004). However, because of the adverse effects of medications (Kripke, 2000) and the problem of accessibility to CBT-I (Unbehaun, Spiegelhalder, Hirscher, & Riemann, 2010), many survivors may seek alternative sleep-management approaches that have minimal adverse effects and easy access.

Exercise has been shown to improve sleep through physiologic mechanisms that include the regulation of immune-inflammatory response (Besedovsky, Lange, & Born, 2012; Lorton et al., 2006), core body temperature (Kunstetter et al., 2014; Nybo, 2012), autonomic function (Sandercock, Bromley, & Brodie, 2005), and endocrine function (Reis et al., 2011), as well as through psychological pathways, such as the improvement of mood status (Paluska & Schwenk, 2000; Taso et al., 2014). Walking has great potential to be an accessible, cost-effective, and feasible approach for managing sleep problems in individuals with cancer, particularly when compared to other forms of exercise (e.g., aquatic exercise, yoga, tai chi, Pilates-based exercises). Although some randomized, controlled trials (RCTs) have shown that walking improves sleep in people with cancer (Cheville et al., 2013; Coleman et al., 2012; Donnelly et al., 2011; Mock et al., 1997; Payne, Held, Thorpe, & Shaw, 2008; Tang, Liou, & Lin, 2010; Wang, Boehmke, Wu, Dickerson, & Fisher, 2011), other studies have produced dissimilar findings (Rogers et al., 2014; Sprod et al., 2010). Two meta-analyses (Mishra, Scherer, Geigle, et al., 2012; Mishra, Scherer, Snyder, et al., 2012) investigating the influence of exercise on sleep in survivors and in patients undergoing active cancer-related treatments, respectively, showed that exercise improved sleep in individuals with cancer. However, a close examination of the reviews revealed that the pooled effect-size calculation was based on

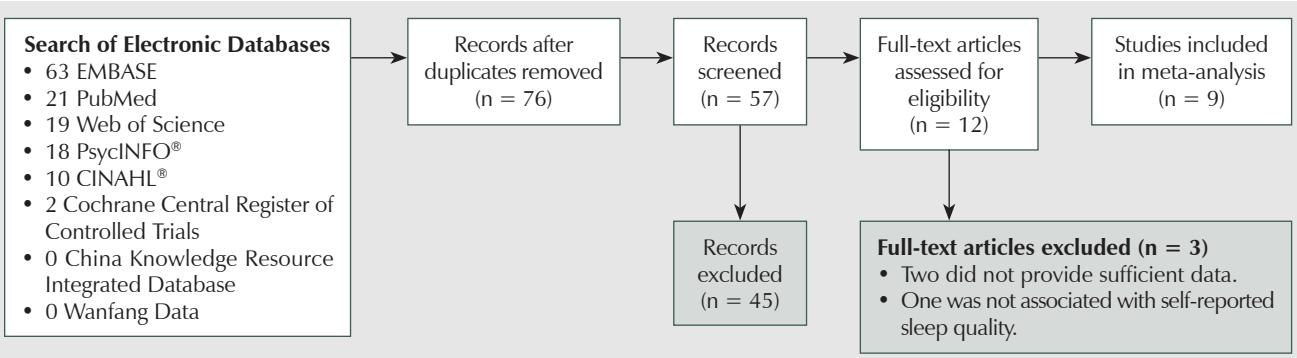

Figure 1. PRISMA Flow Diagram

pre- to-post-test change scores or post-test scores. Combining the two different summary measures to estimate the effect size is methodologically erroneous. A reexamination of the effect of exercise on sleep in people with cancer is warranted. In addition, these meta-analyses included studies that used various types of exercise (e.g., walking programs, aquatic exercise, yoga, tai chi, Pilates-based exercises), which hinders the determination of whether walking exercise alone exerts a distinct effect on sleep disturbance in individuals with cancer. An updated meta-analysis of studies focusing on the effects of walking exercise on sleep among people with cancer is clinically relevant.

The authors of the current study conducted a meta-analysis of RCTs to determine the effect of walking exercise on sleep in individuals with cancer, and whether intervention components, patient characteristics, and methodologic features modulate the effects of walking exercise on sleep.

Methods

Search Strategies

The authors' meta-analysis was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009). Relevant studies were identified through searches of the following databases: China Knowledge Resource Integrated Database, CINAHL®, Cochrane Central Register of Controlled Trials, EMBASE, PsycINFO®, PubMed, Wanfang Data, and Web of Science. The search terms used were "*sleep* OR *sleep disturbance* OR *sleep quality* OR *insomnia*," "*cancer* OR *tumour* OR *tumor* OR *neoplasm* OR *chemotherapy* OR *radiotherapy*," and "*home-based walking exercise* OR *walking exercise*." The date range was from the earliest publication date available in each database to May 2014. To confirm whether any relevant studies were published since the author's initial search, the search was updated on July 15, 2014.

Selection Criteria

Studies involving individuals who had been diagnosed with any type of cancer and were aged 18 years or older were eligible for inclusion in the current study. In addition, studies in which walking had been used as the intervention were included, as were studies that included an alternative treatment group or an inactive control group (e.g., wait list, no treatment, usual care or exercise style).

Studies that assessed a self-reported sleep outcome using validated scales (e.g., Pittsburgh Sleep Quality Index [PSQI], symptom Numeric Rating Scale, Symptom Assessment Scale, European Organisation for the Research and Treatment of Cancer Quality-of-Life Questionnaire–Core 30 [EORTC QLQ-C30]) were included. The PSQI is a 19-item scale that evaluates sleep quality during a one-month period. It has seven components that can be summed to obtain a global sleep quality score ranging from 0–21. A global PSQI score of greater than 5 is indicative of poor sleep quality. The PSQI exhibits good reliability and validity; the Cronbach alpha is 0.83, and concurrent validity is r = 0.33 (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). The 11-point symptom Numeric Rating Scale is a valid sleep measure, with a concurrent validity of r = 0.85 (Paice & Cohen, 1997). Higher scores indicate better sleep quality. The Symptom Assessment Scale measures sleep using a series of straight 100 mm lines, with higher scores reflecting worse sleep quality (Wewers & Lowe, 1990). The scale is considered to be reliable and valid; the test-retest reliability has been found to be 0.95–0.99, and the criterion-related validity is 0.42–0.91. The EORTC QLQ-C30 comprises five function and nine symptom subscales (one item assesses sleep) measuring sleep quality, with higher scores representing poorer sleep quality. The reliability and validity of the questionnaire have been established; the Cronbach alpha is 0.43–0.68, and the concurrent validity is 0.78–0.81 (Fredheim, Borchgrevink, Saltnes, & Kaasa, 2007; Groenvold, Klee,

Sprangers, & Aaronson, 1997). Studies using a prospective RCT design that were published or accepted for publication in English or Chinese by a peer-reviewed journal were included.

Study Selection

Two investigators independently screened the titles and abstracts of articles identified using the search strategy previously described. After removing duplicate publications using Thomson Reuters EndNote X7, the remaining articles were reviewed in full. Only studies fulfilling the selection criteria were included in the current meta-analysis.

Data Extraction and Methodology Quality Assessment

Two investigators developed a data extraction sheet and independently extracted the data from each study, including (a) characteristics of the selected studies (e.g., authors' names and year of publication), (b) characteristics of the patient populations (e.g., type of cancer, patient age, number of patients in each group, percentage of women in the sample), (c) characteristics of the intervention (e.g., type, frequency, length, and intensity of exercise), and (d) outcome measures. Quantitative data were extracted to calculate the effect size. When assessment time points were greater than one, the immediate postintervention measure was selected. Discrepancies were rechecked by the corresponding author of the current article and consensus was achieved by discussion.

The following domains were assessed in relation to their risk of bias (Higgins & Green, 2011): (a) random sequence generation, (b) allocation concealment, (c) blinding of participants and staff, (d) blinding of outcome assessment, (e) incomplete outcome data, and (f) selective reporting. Each domain was rated as having "low," "unclear," or "high" risk of bias. Two reviewers independently performed the assessment of potential bias for each study, with a third reviewer serving as the arbitrator.

Table 1. Sample Characteristics

Characteristic	$\bar{X}$	SD
Patient (N = 599)		
Age (years)	54.39	5.74
Characteristic	**n**	**%**
Gender		
Female	388	65
Male	211	35
Type of cancer		
Breast	253	42
Other	346	58
Study Design (N = 9)		
Cancer treatment at enrollment		
During only	5	56
Before, during, and after	4	44
Outcome measurement		
EORTC QLQ-C30	1	11
PSQI	6	67
Symptom Assessment Scale	1	11
Symptom Numeric Rating Scale	1	11
Sample size		
Control group	298	50
Intervention group	301	50
Sleep as the primary outcome		
No	6	67
Yes	3	33
Use of intention to treat analysis		
No	2	22
Yes	7	78

EORTC QLQ-C30—European Organisation for the Research and Treatment of Cancer Quality-of-Life Questionnaire–Core 30; PSQI—Pittsburgh Sleep Quality Index

Data Analysis

Quantitative data were entered into Biostat Comprehensive Meta-Analysis, version 2.0. Two-sided p values were calculated, with $p < 0.05$ set as the level of statistical significance. First, pre- to post-test change scores were derived for the intervention group and control group from each included study. Then, the effect size for the difference between the intervention and control groups was calculated for each study. Hedges' g was used as the measure of the effect size. It was calculated by finding the difference between the intervention and control group means (d), divided by their pooled standard deviation and multiplied by a factor (J) that corrects for underestimation of the population standard deviation. A forest plot was used to present the effect size of all of the included studies. An inverse variance random-effects model was applied to analyze the data because it is more conservative than a fixed-effects model (DerSimonian & Laird, 1986).

To establish whether the selected studies differed significantly, the authors of the current study first examined whether the interstudy heterogeneity was statistically significant by evaluating the Cochran Q statistic (Higgins, Thompson, Deeks, & Altman, 2003), with $p < 0.05$ indicating significant heterogeneity. The magnitude of heterogeneity was measured using the I^2 statistic, with I^2 of 50% or greater indicating substantial heterogeneity across studies. A sensitivity analysis was also performed by removing the study with the largest effect size to determine its contribution to the overall effect size in the current meta-analysis.

Subgroup analyses were conducted by dividing the studies into groups according to (a) type of intervention, (b) type of cancer, (c) whether sleep was the primary outcome, (d) stage of cancer treatment at

Table 2. Study Intervention Characteristics

Study	Interventions	Comparison	Session Length (Minutes)	Session Frequency (Weekly)	Study Length (Weeks)	Intensity	Adherence Rate[a]	Attrition Rate (E/C)
Cheville et al., 2013	Instructions, home-based walking with pedometer, strength training	Usual care	90	4	8	Moderate (3.5 MET)	76.9	21.2/9
Donnelly et al., 2011	Consultants, home-based walking and strength, telephone calls	Usual care	30	5	12	Moderate	58	6/0
Mock et al., 1997	Walking, diaries	Usual care	20–30	4–5	6	–	86	8 (overall)
Rogers et al., 2014	Supervised aerobic walking, home-based walking, strength, discussion sessions	Usual exercise style	40	4	12	Moderate	91	5/4
Sprod et al., 2010	Instruction sessions, home-based walking, resistance training	Usual care	–	7	4	Moderate (ACSM revised RPE 3–5)	–	5/5
Tang et al., 2010	Walking, diaries	Usual exercise style	30	3	8	Moderate (RPE 11–13)	89	0/0
Wang et al., 2011[b]	Home-based walking, daily log	Usual care	30	3–5	6	Moderate (HR_{max} 40%–60%)	93.3	17/11
Wenzel et al., 2013	Home-based walking with pedometer, daily log	Usual care	20–30	5	5–35	Moderate (HR_{max} 50%–70%)	32.4	1.4/0
Wiskemann et al., 2011	Home-based walking (O)/bicycling and treadmill walking (H), strength training	Usual exercise style	20–40	3–5 (O) 6–10 (H)	–	Moderate to vigorous (RPE 12–14)	87	23/24.5

[a] Rates pertain to the intervention group.

[b] Adverse effects included anemia, dizziness, and dyspnea.

ACSM—American College of Sports Medicine; C—control group; E—experimental group; H—hospitalization; HR_{max}—heart rate maximum; MET—metabolic equivalent; O—outpatient; RPE—rating of perceived exertion

enrollment, (e) whether random sequence generation was appropriately executed (risk of selection bias), and (f) whether allocation concealment was appropriately executed (risk of selection bias). Moderator analyses were performed to explore possible reasons for the observed heterogeneity. To ensure sufficient data for analyses, each moderator analysis was limited to instances in which groups were represented by at least three studies. For categorical moderators, a mixed-effect model was used to compare differences among the effect sizes in each comparison (Lipsey & Wilson, 2001). Metaregression was used for the analyses of continuous moderators (Lipsey & Wilson, 2001).

Begg's rank correlation (Begg & Mazumdar, 1994) and Egger's intercept (Egger, Davey Smith, Schneider, & Minder, 1997) assess potential publication bias, with $p > 0.05$ indicating significant publication bias. The trim-and-fill method (Duval & Tweedie, 2000) was applied using a funnel plot to further assess potential publication bias. The overall effect size was adjusted by taking into account the estimated effect sizes of missing studies.

Results

The literature search initially identified 132 articles. Among these, 76 duplicates were excluded, and 45 articles were excluded because they were not RCTs or because they used patients and interventions that did not satisfy the current authors' selection criteria. Three

of the 12 remaining studies were excluded because they did not provide sufficient data to compute an effect size even after the authors were contacted (Payne et al., 2008; Rogers et al., 2009) or did not examine a self-reported sleep outcome (Coleman et al., 2012). The remaining nine studies were included in the current meta-analysis (Cheville et al., 2013; Donnelly et al., 2011; Mock et al., 1997; Rogers et al., 2014; Sprod et al., 2010; Tang et al., 2010; Wang et al., 2011; Wenzel et al., 2013; Wiskemann et al., 2011). This process is illustrated in Figure 1.

Study Characteristics

Patient demographic and disease characteristics are presented in Table 1. Study sample sizes ranged from 16–68 patients, with a total population of 599 randomized patients. Study participants were predominately women (65%). About half of the patients (42%) had a diagnosis of breast cancer. The most frequently used sleep measure was the PSQI.

Details of the study intervention characteristics are presented in Table 2. In four studies, the interventions consisted solely of walking, whereas five studies used walking combined with other interventions (e.g., other exercise activities, a discussion group). The mean length of intervention was 9.5 weeks. The mean duration of an intervention session was 37.5 minutes, and the mean number of sessions per week was 4.5. The mean total intervention time was 1,602.1 minutes, with total intervention time in each study ranging from 675–2,880 minutes. The intensity of exercise was moderate in most of the studies. One study did not report the intensity of exercise, seven employed moderate-intensity exercise, and one used moderate-to-vigorous exercise. Only one study reported the time of day when the exercise was performed. The average adherence rate to walking exercise was 77%. Six trials did not document any adverse effects. Results of the methodologic quality assessment of the selected studies are shown in Table 3.

Effects of Walking on Sleep

The pooled mean effect sizes for the nine selected studies are shown in Tables 4 and 5. The weighted mean effect size was –0.52 (95% confidence interval [CI] [–0.79, –0.25]). No outlier was found because all effect sizes fell within two standard deviations of the mean. A sensitivity analysis was performed by removing the study with the largest effect size (Tang et al., 2010). The effect size of the walking interventions remained statistically significant (k = 8, Hedges' g = –0.41). The Cochran Q (Q = 20.3, p = 0.009) and I^2 statistics (61%) indicated significant heterogeneity across the nine selected studies. Therefore, subgroup analyses, moderator analyses, and metaregression were performed to further explore factors that might have contributed to the heterogeneity.

Subgroup Analysis

Walking alone (Hedges' g = –0.7) and walking combined with other forms of exercise (Hedges' g = –0.34) significantly improved sleep. Walking significantly improved sleep in individuals with breast cancer or other types of cancer (Hedges' g = –0.56 and –0.5, respectively). The effect sizes of studies in which sleep was the primary outcome (Hedges' g = –0.53) and studies in which sleep was the secondary outcome (Hedges' g = –0.52) were statistically significant. The effect size for both subgroups, divided according to the stage of cancer treatment at enrollment, were statistically significant (Hedges' g = –0.53 and –0.51, respectively).

Moderator Analysis and Metaregression

In terms of the categorical moderators, none of the factors were found to moderate the relationship between walking exercise and sleep improvement (p > 0.05). For the continuous moderators, the overall effect sizes were not significantly associated with age, the percentage of female patients, the duration of each intervention session, and the adherence rate (p = 0.92, 0.22, 0.46, and 0.44, respectively).

Publication Bias

According to the Egger's test, the intercept of the effect size was –2.47, and the t value was 1.02 (two-tailed p = 0.34). In the Begg's test, Kendall's tau with continuity correction was –0.03, and the z value was 0.1 (p = 0.92). The

Table 3. Risk of Methodologic Bias Score of Included Studies

Study	Random Sequence Generation	Allocation Concealment	Blinding of Outcome Assessment	Incomplete Data Addressed
Cheville et al., 2013	L	L	H	L
Donnelly et al., 2011	L	L	L	L
Mock et al., 1997	H	H	H	U
Rogers et al., 2014	L	L	H	L
Sprod et al., 2010	L	H	H	L
Tang et al., 2010	L	H	H	L
Wang et al., 2011	U	H	H	L
Wenzel et al., 2013	U	H	H	L
Wiskemann et al., 2011	L	H	H	L

H—high risk; L—low risk; U—unclear risk

Note. All studies had a low risk of selective reporting and a high risk of blinding of participants and personnel.

results of the Egger's and Begg's tests indicated that no evidence of publication bias exists. The funnel plot indicated a potential selection bias. Therefore, the mean effect size was recalculated based on estimates for the missing studies using the trim-and-fill method, yielding an adjusted effect size of –0.58 (95% CI [–0.85, –0.31]).

Discussion

To the best of the authors' knowledge, this is the first meta-analysis entailing the effects of walking on sleep in individuals with cancer. Overall, the authors of the current study found that walking improved sleep, with an effect size of –0.51. Previous meta-analyses could not determine whether exercise programs improve sleep in people with cancer (Mishra, Scherer, Geigle, et al., 2012; Mishra, Scherer, Snyder, et al., 2012), but the current authors' findings show support for exercise's ability to improve sleep in individuals with cancer.

The intensity and timing of workouts are important factors in the sleep-related effects of exercise (Driver & Taylor, 2000). A previous meta-analysis demonstrated that moderate-to-vigorous exercise, rather than mild exercise, resulted in fewer sleep problems in individuals with cancer (Mishra, Scherer, Snyder, et al., 2012). Most studies included in this meta-analysis used moderate-intensity walking exercise. The current authors' findings and those from previous studies collectively indicate that moderate-intensity exercise should be recommended for improving sleep in individuals with cancer. Unfortunately, most studies included in this meta-analysis did not report the time of day when exercise sessions were performed. Future studies of exercise programs for individuals with cancer should address this factor in their experimental design.

Moderator analyses of intervention types revealed that walking exercise alone produced a treatment effect similar to that of a combination of walking and other forms of exercise. Therefore, walking alone is sufficient to improve sleep in individuals with cancer. The current authors also found that walking produced a treatment effect in individuals with breast cancer similar to that in patients with other types of cancer. Most of the studies included in this meta-analysis involved individuals with breast cancer; additional RCTs that investigate the beneficial effects of walking in individuals with different types of cancer are warranted. In addition, this meta-analysis revealed that walking significantly improved sleep among

Table 4. Mean Effect Sizes, Moderator Analyses, and Study Quality Analyses

Parameter	k	Effect Size (Hedges' g)	95% CI	p
Categorical Moderators				
Allocation concealment				
High and unclear risk	6	–0.52[c]	[–0.86, –0.18]	0.97[d]
Low risk	3	–0.53[c]	[–1.05, –0.01]	
Cancer treatment at enrollment				
During only	5	–0.53[c]	[–0.92, –0.14]	0.94[d]
Before, during, after	4	–0.51[c]	[–0.95, –0.07]	
Cancer type				
Breast cancer	3	–0.56[c]	[–1.06, –0.06]	0.86[d]
Others[a]	6	–0.5[c]	[–0.85, –0.16]	
Random sequence generation				
High and unclear risk	3	–0.53[c]	[–1.02, –0.06]	0.95[d]
Low risk	6	–0.53[c]	[–0.88, –0.15]	
Sleep as the primary outcome				
No	6	–0.52[c]	[–0.88, –0.15]	0.97[d]
Yes	3	–0.53[c]	[–1.02, –0.04]	
Type of intervention				
Walking exercise alone	4	–0.7[c]	[–1.08, –0.31]	0.22[d]
Walking exercise combined with other forms of interventions[b]	5	–0.34[c]	[–0.73, –0.02]	
Parameter	**k**	**β**	**95% CI**	**p**
Continuous Moderators				
Adherence rate	8	–0.005	–	0.44[e]
Age	9	0.002	–	0.92[e]
Duration per session	8	–0.005	–	0.46[e]
Percentage of male to female participants	9	–0.005	–	0.22[e]

[a] Neoplastic hematologic disorders, as well as colorectal, gastrointestinal, gynecologic, lung, nasopharyngeal, lung, and other cancers

[b] Discussion or instruction sessions, consultant, strength or resistance training, or bicycling

[c] Significant at $p < 0.05$

[d] Test for moderator effect

[e] Metaregression

CI—confidence interval

Note. The overall effect size was k = 3, Hedges' g = –0.52; sensitivity analysis was 6, Hedges' g = –0.41.

Table 5. Effect Sizes for Studies Measuring Sleep

Study	Hedges' g	Standard Error	Variance	Lower Limit	Upper Limit	z	p
Cheville et al., 2013	–0.858	0.279	0.078	–1.404	–0.312	–3.081	0.002
Donnelly et al., 2011	–0.545	0.346	0.12	–1.224	0.134	–1.574	0.116
Mock et al., 1997	–0.674	0.298	0.089	–1.259	–0.089	–2.256	0.024
Rogers et al., 2014	–0.15	0.304	0.092	–0.745	0.445	–0.494	0.621
Sprod et al., 2010	–0.164	0.318	0.101	–0.787	0.46	–0.515	0.607
Tang et al., 2010	–1.23	0.256	0.066	–1.732	–0.727	–4.795	–
Wang et al., 2011	–0.791	0.242	0.059	–1.266	–0.315	–3.262	0.001
Wenzel et al., 2013	–0.206	0.178	0.032	–0.555	0.143	–1.158	0.247
Wiskemann et al., 2011	–0.125	0.194	0.038	–0.505	0.255	–0.646	0.518

Note. The mean effect size for all studies is: Hedges' g = –0.517, standard error = 0.137, variance = 0.019, lower limit = –0.787, upper limit = –0.248, z = –3.765.

individuals with cancer before, during, and after cancer treatment. Although the current authors were unable to perform a meta-analytical analysis of possible harms associated with walking in this patient population, one of the included studies revealed that the adverse effects associated with walking were minimal (Wang et al., 2011). Walking is considered to be a relatively safe and effective approach for improving sleep in individuals with cancer at any treatment period. Healthcare providers must inform the individuals with cancer who are suffering from sleep problems about the benefit of walking as exercise.

Limitations

Although some of the studies included in this meta-analysis were less than optimal in terms of internal validity, the risk of bias associated with random sequence generation and allocation concealment did not affect the magnitude of effect size. In addition, certain design features of the current study support the strength of the authors' findings. First, the meta-analysis used specific inclusion criteria with regard to the type of exercise; it also used a large total sample size. Second, the inclusion of only RCTs greatly increased the internal validity of the meta-analysis. However, several limitations must be taken into consideration. The exclusion of studies based on language might have limited the external validity of findings. In some studies, sleep was not the primary outcome. Two included studies (Donnelly et al., 2011; Wenzel et al., 2013) had fairly low adherence rates (i.e., 32% and 58%), and the overall sample size for included studies was small. In addition, the type and duration of walking were not consistent across studies. Finally, about 43% of participants were individuals with breast cancer, which, again, may limit generalizability of the findings.

Knowledge Translation

Moderate-intensity walking exercise effectively improves sleep in individuals with cancer.

Individuals with cancer can adopt walking exercise before, during, or after cancer treatment as a means to improve sleep.

Walking exercise can be an accessible and feasible approach to managing sleep problems in individuals with cancer.

Implications for Nursing and Conclusions

The current authors' findings support the idea that walking exercise can be adopted into the multimodal approaches to managing sleep in individuals with cancer. Healthcare providers must convey the effectiveness of walking exercise to individuals with cancer who are facing sleep problems.

Moderate-intensity walking is a safe and effective approach to improving sleep among individuals with cancer. Based on the findings of the moderator analyses, walking could be adopted by people with different types of cancer across different treatment stages. It could be used as a stand-alone treatment or in combination with other forms of interventions. To avoid the occurrence of adverse effects resulting from exercise, a medical assessment of cardiovascular and pulmonary functions may be needed beforehand.

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