Original Article
Effects of home-based physical activitieson the health outcomes in early-stage breast cancer survivors: a meta-analysis

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Abstract: Several studies have focused on the difference in the alterations of health outcomes between usual care (UC) and home-based physical activity for survivors of early-stage breast cancer (ESBC), but the results are inconclusive. We performed the current research to comprehensively explore the difference with body composition, quality of life and fatigue as indices for health outcomes. The multiple databases were searched from the inception to Dec. 31 2015 with strict inclusion and exclusion criteria for literature retrieval. The Standardized Mean Difference (SMD) and corresponding 95% confidence interval (CI) for each parameter were calculated in 9 studies fulfilled the inclusion criteria. For body composition, no significant difference in the alterations of body mass index (BMI) (SMD = -0.069, p = 0.424) and percent body fat (SMD = -0.229, p = 0.117) between UC and home-based physical activity was observed for survivors of ESBC. With regard to the quality of life, compared with UC, the home-based physical activity intervention significantly improved the physical well-being (PWB) (SMD = 0.331, p = 0.004), social well-being (SWB) (SMD = 0.236, p = 0.038), emotional well-being (EWB) (SMD = 0.344, p = 0.003) and functional assessment of cancer therapy-general (FACT-G) (SMD = 0.490, p = 0.034) in ESBC survivors. As for the fatigue, the two interventions had similar effects on the FACT-fatigue (FACT-F) (SMD = -0.015, p = 0.945) in ESBC survivors. Our meta-analysis suggests that the home-based physical activity significantly improve quality of life for ESBC survivors but has no significant impact on the body composition and fatigue as compared to UC.
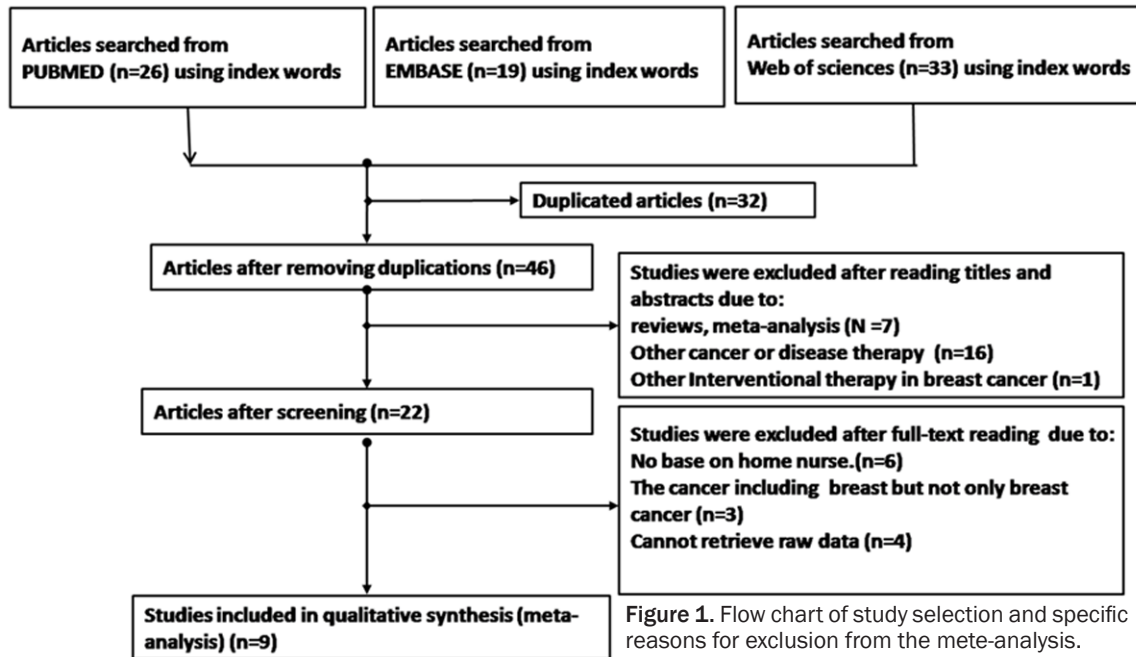
Keywords: ESBC survivors, body composition, quality of life, fatigue, meta-analysis

Introduction

Breast cancer (BC), which is indicated by demographics to be a continuous increase in incidence, is the most common malignancy worldwide and the second leading cause of tumor-related death for females in Europe [1-3]. It is estimated that there will be about 394,000 new cases diagnosed with BC annually by 2020 in European Union [1]. And approximately half of the new cases present with early-stage BC (ESBC) that includes ductal tumor in situ, stages I, IIA, IIB, and IIIA [4, 5]. With our knowledge for biology of BC accumulating, progression has been made in the management of ESBC over the past decade, which results in an increase in survival and more BC survivors [6, 7].

BC survivors usually suffer from increased weight, reduced quality of life and fatigue [8].

Considering these side effects and the continually increasing survival rates of BC, more concerns have been attracted to improve the quality of life in BC survivors [9]. Physical activity, which has various forms including walking, jogging, cycling, yoga and so on, has been documented to be likely to reduce mortality and toimprove psychosocial health outcomes for BC [9, 10]. The hospital-based or group-based physical activity usually restricts participation for patients due to the high cost or limited access to exercise facilities or scheduling difficulties [9]. Moreover, some survivors of BC are not meeting the recommended physical activity guidelines [11]. So the self-managed home-based physical activity, if may produce favorable clinical outcomes for survivors of BC, will be a promising intervention for post-treatment patients with BC.

Figure 1. Flow chart of study selection and specific reasons for exclusion from the mete-analysis.

A case-control study, published in 2015, aimed to investigate the effects of both usual care (UC) and the home-based Better Exercise Adherence after Treatment (BEAT) for Cancer (BEAT Cancer) on quality of life insurvivorsof ESBC, and found that compared with UC, the home-based physical activity (BEAT Cancer) intervention significantly improved the quality of life insurvivors of ESBC [11]. However, Lisa performed a randomized controlled trial to explore the effect of home-based physical activityon quality of life insurvivors of ESBC, and observed that the home-based physical activitydid not significantly improve the quality of life insurvivors of ESBC when compared to UC [8]. Herein, in order to comprehensively evaluate the difference in the alterations of health outcomes between UC and home-based physical activity for survivors of ESBC, we performed the current meta-analysis with body composition, quality of life and fatigue as indices for health outcomes.

Materials and methods

Search strategy

We searched multiple databases such as PubMed (1966~2015), EMBASE (1980~2015) and Web of science (1945~2015) for literature retrieval. The search terms were set as "breast cancer" "home-base" "exercise" and "usual care". The literature search was finish-ed on Dec. 31 2015. We excluded duplicated literatures.

Inclusion and exclusion criteria

We incorporated literatures meeting the following inclusion criteria in our meta-analysis: (1) patients with ESBC (stage 0-III); (2) all ESBC patients have received chemotherapy or/and radiotherapy; (3) patients in one arm receiving UC (control group), in the other arm receiving home-based physical activity invention (case group); (4) studies published in English. The exclusion criteria were as follows: (1) patients with ESBC accompanied with other tumors; (2) studies in which the raw data unavailable; (3) literatures in the forms of abstracts, communications, letters and news.

Data extraction

The eligibility of literatures was assessed by two reviewers and the inconsistency was settled by consensus. The following data were collected and extracted from the included studies: the first author, year of publication, intervention for case group, the home-based physical activity in each included study, previous treatment, tumor stage, body mass index (BMI) and age of participants, thre shold of heart rate for physical activity, number of patients in case and control groups and follow-up time.

Table 1. Summary of eligible articles

Study	Intervention for case group	Method	Previous treatment	Cancer stage	BMI	Age (mean ± SD)	Threshold of heart rate for physical activity	Number of patients in case group	Number of patients in control group	Follow-up time
Charles E. Matthews (2007)	Home-based walking intervention	Walk 3-5 times/week (20-40 min/session)	CT and/or RT	Stage 0-III	28.6 (5.8)	51.3 (9.0) 56.9 (12.3)	-	22	14	12 weeks
Kajal Gokal (2015)	Home-based moderate intensity walking	Walk 5 times/week (10-30 min/session)	CT	Stage 0-III	27.72	52	-	25	25	12 weeks
Laura Q. Rogers (2009)	Home-based exercise intervention	Walking	CT and/or RT	Stage I, II, or IIIA	-	53 (9)	85%	21	20	12 weeks
Laura Q. Rogers (2015)	Home-based exercise intervention	Exclusively home exercise program	No CT and RT	Stage I-III	-	54.4 (8.5)	40 Matthews 59%	110	112	24 weeks
Lisa A. Cadmus (2009)	Home-based exercise intervention	Moderate-to-vigorous sports/ recreational physical activity	CT and/or RT	Stage 0-IIIA	27.7 (5.3)	54.2 (9.6)	60-80%	25	25	24 weeks
Melinda L. Irwin (2009)	Either gym-based or home-based aerobic exercise	Sessions 3 times per week	CT and/or RT	Stage 0-IIIA	30.2 (6.7)	55.8 (8.7)	60%-80%	37	38	24 weeks
Nanette Mutrie (2007)	Home-based exercise intervention	20 minutes of exercise	CT and/or RT	Stage 0-III	27.4 (5.6)	51.6 (9.5)	50-75%	99	102	24 weeks
Victoria Mock (2005)	Home-based moderate-intensity walking exercise program	15-30 minute walk	CT and/or RT	Stage I-III	<35 kg/m^2 25.7 (4.6)	51.5 (9.3)	50-70%	54	54	6 weeks
Ya-Jung Wang (2011)	Home-based walking program	Walk	CT and/ or RT	Stage I-II	<30 kg/m^2	50.42 (9.64)	40-60%	30	32	6 weeks

BMI: body mass index; SD: standard deviation.

Table 2. The meta-analysis of the difference in the alterations of health outcomes between UC and home-based physical activity in survivors of ESBC

Study	SMD	Lower Limit	Upper Limit	P (SMD)	I²	P (Heterogeneity)	P (Begg's Test)	P (Egger's test)
BMI	-0.069	-0.237	0.100	0.424	<0.01%	0.743	0.806	0.792
Percent body fat	-0.229	-0.516	0.057	0.117	<0.01%	0.783	0.734	0.657
PWB	0.331	0.107	0.556	0.004	24.50%	0.125	0.296	0.214
SWB	0.236	0.013	0.460	0.038	51.90%	0.266	1.000	0.886
EWB	0.344	0.12	0.568	0.003	<0.01%	0.565	1.000	0.767
FWB	0.052	-0.615	0.718	0.879	82.90%	0.003	0.296	0.003
FACT-G	0.490	0.037	0.942	0.034	88.50%	<0.001	0.707	0.489
FACT-F	-0.015	-0.430	0.400	0.945	85.10%	<0.001	0.308	0.135

Abbreviations: BMI: Body Mass Index; PWB: physical well-being; SWB: social well-being; EWB: emotional well-being; FWB: functional well-being; FACT-G: functional assessment of cancer therapy-general; FACT-F: functional assessment of cancer therapy-fatigue; SMD: Standardized Mean Difference.

Statistical analysis

According to the previous relevant studies [10-14], the changes in BMI and percent body fat were used to measure the alteration of body composition; the changes in physical well-being (PWB), social well-being (SWB), emotional well-being (EWB), functional well-being (FWB) and functional assessment of cancer therapy-general (FACT-G) were as indices for the alteration of quality of life; and the change in functional assessment of cancer therapy-fatigue (FACT-F) was considered as the index for the alteration of fatigue. We analyzed the data using the STATA 12 software (STATA Corp LP, College Station, Texas, United States). For continuous outcomes, when means, SDs, and sample sizes were available, standardized mean differences (SMDs) with 95% confidence intervals (CIs) were calculated between the intervention and control groups, with P<0.05 considered as statistical significant. The heterogeneity among included studies was estimated with I² index, and the Mantel-Haenszel (M-H) fixed-effects model was adopted to measure the I² index. When the I² index was less than 50%, low heterogeneity was considered and the Inverse-Variance (I-V) fixed-effects model was chosen to calculate the SMD with 95% CI. If there was high heterogeneity (I² > 50%), the DerSimonian and Laird (D-L) random-effects model was applied for the calculation of SMD and the corresponding 95% CI. The forest plots were constructed.

In our study, we regarded the data in control group (UC) as reference to calculate the SMD and the corresponding 95% CI. A SMD > 0 signifies that the alterations of indices in case group (home-based physical activity) are larger than those in control group (UC). As for the publication bias, we used the Begg's test and Egger's test to examine them, and the value of *p* less than 0.05 was considered as statistically significant difference.

Results

Study characteristics

After first search, 26 literatures were retrieved from PubMed, 19 from EMBASE and 33 from Web of science. We eliminated 32 duplicated literatures, leaving 46 literatures for further assessment. We then excluded 24 literatures after screening the titles and abstracts. Finally, a total of 9 literatures were eligible for our meta-analysis based on the pre-defined inclusion and exclusion criteria. And the reasons for study inclusion and exclusion were illustrated in **Figure 1**. The characteristics of the eligible articles were displayed in **Table 1**.

Comparison of effects of UC and home-based physical activity on body composition

We used BMI and percent body fat as indices for body composition. There were 5 and 4 eligible studies for the analysis of BMI and percent body fat, respectively. The results were shown in **Table 2**. The I² for BMI and percent body fat were lower than 0.01%, so we selected the fixed-effects model to calculate the SMD and 95% CI. The SMDs were -0.069 and -0.229 for BMI and percent body fat, respectively (BMI: 95% CI: -0.237-0.100, **Figure 2A**; percent body fat: 95% CI: -0.516-0.057, **Figure 2B**), and the values of *p* were higher than 0.05 (BMI: p =

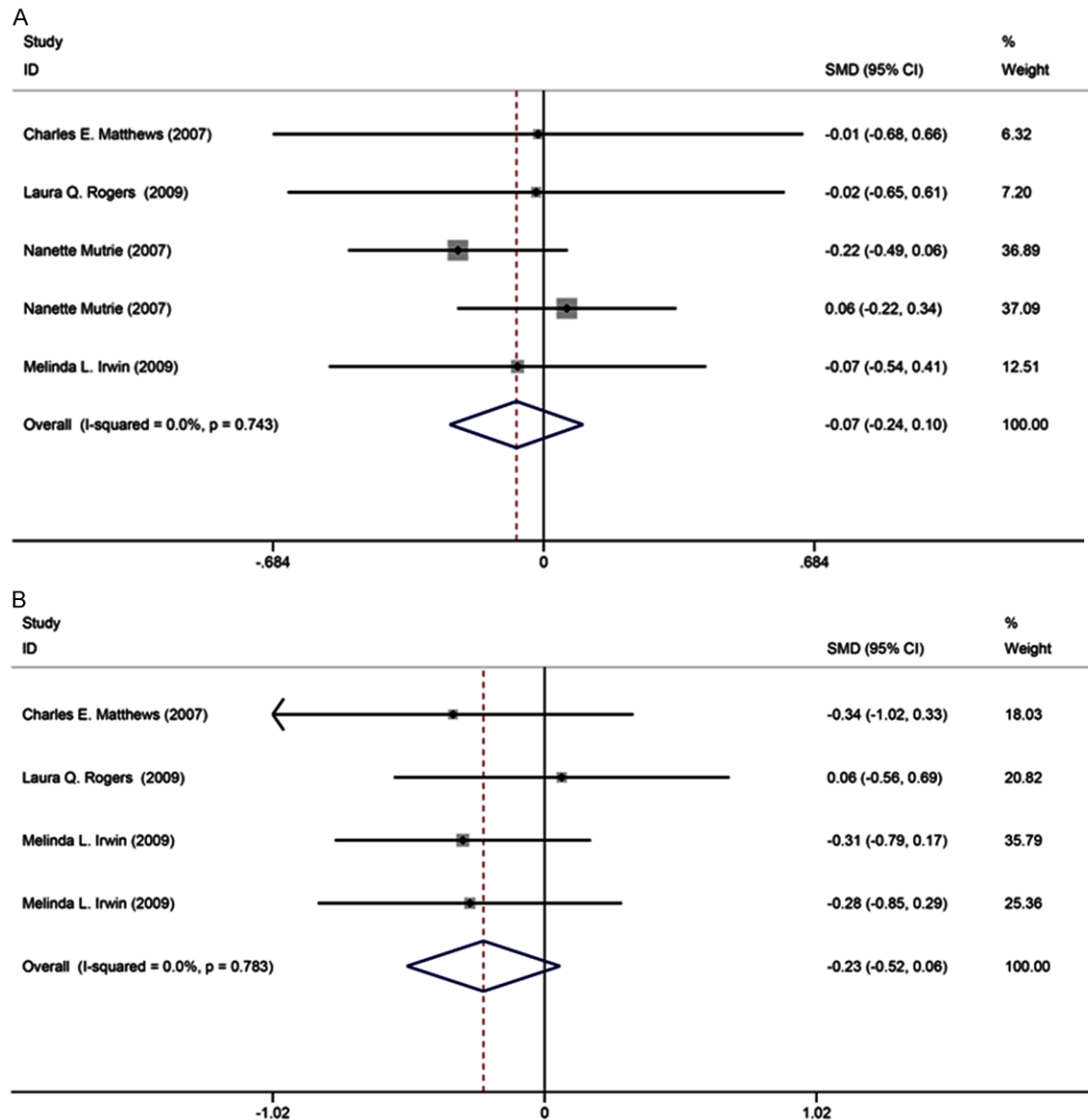The effect of home-based exercise on ESBC survivors

A

B

Figure 2. Forest plot of study evaluating the difference in the alteration of BMI (A) and percent body fat (B) between UC and home-based physical activity for survivors of ESBC.

0.424; percent body fat: p = 0.117), which demonstrated that no significant difference in the alterations of BMI and percent body fat between UC and home-based physical activity was observed for survivors of ESBC.

Comparison of effects of UC and home-based physical activity on the quality of life

The quality life for survivors of ESBC wasmeasured by PWB, SWB, EWB, FWB and FACT-G. For PWB, the fixed-effects model was used to calculate the SMD and 95% CI due to the low heterogeneity, and the results were displayed

in **Table 2**. The SMD was 0.331 with 95% CI ranged from 0.107 to 0.556 (**Figure 3A**), and the value of p was less than 0.05 (p = 0.004), indicating that the alteration of PWB in home-based physical activity group was significantly larger than that in UC. With respect to SWB, the random-effects model was adopted for the calculation of SMD and 95% CI, and the results were documented in **Table 2**. The value of p was 0.038 (SMD = 0.236, 95% CI: 0.013-0.460, **Figure 3B**), which signified that survivors of ESBC in home-based physical activity group had significantly larger alteration of SWB than those in UC group.
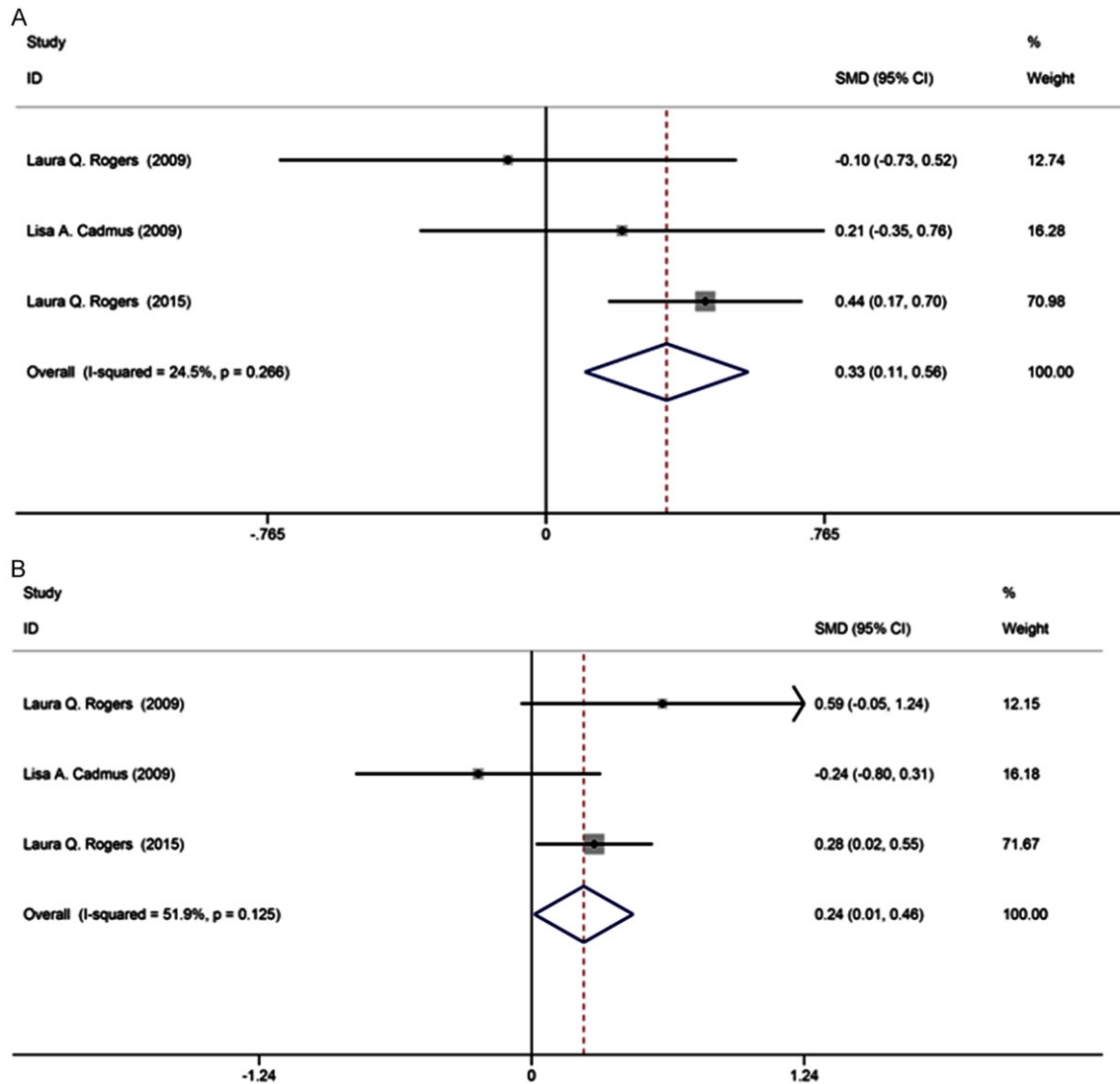
Figure 3. Forest plots of study assessing the difference in the alterations of PWB (A) and SWB (B) between UC and home-based physical activity for survivors of ESBC.

Considering the low heterogeneity, the fixed-effects model was chosen to calculate the SMD and 95% CI of EWB, and the results were shown in **Table 2**. The SMD was larger than 0 (SMD = 0.344, 95% CI: 0.12-0.568, p = 0.003, **Figure 4A**), suggested that the alteration of EWB in home-based physical activity group was significantly larger than that in UC group. As for FWB, although the SMD was higher than 0 (SMD = 0.052, 95% CI: -0.615-0.718, **Figure 4B**), the value of p was larger than 0.05 (p = 0.879), and we still believed that there was no significant difference in the alteration of FWB between the two groups after intervention.

In terms of FACT-G, 6 eligible studies were incorporated in the analysis, and the results were exhibited in **Table 2**. The random-effects model was used for the calculation of SMD with 95% CI due to the large heterogeneity. The SMD was 0.490 (95% CI: 0.037-0.942, **Figure 5**) with the value of p less than 0.05 (p = 0.034), which suggested that survivors of ESBC receiving home-based physical activity had significantly larger alteration of FACT-G than those receiving UC intervention.

Comparison of effects of UC and home-based physical activity on fatigue

The fatigue in survivors of ESBC was measured by FACT-F. We chose the random-effects model to calculate the SMD and 95% CI, and the results were recorded in **Table 2**. The SMD was
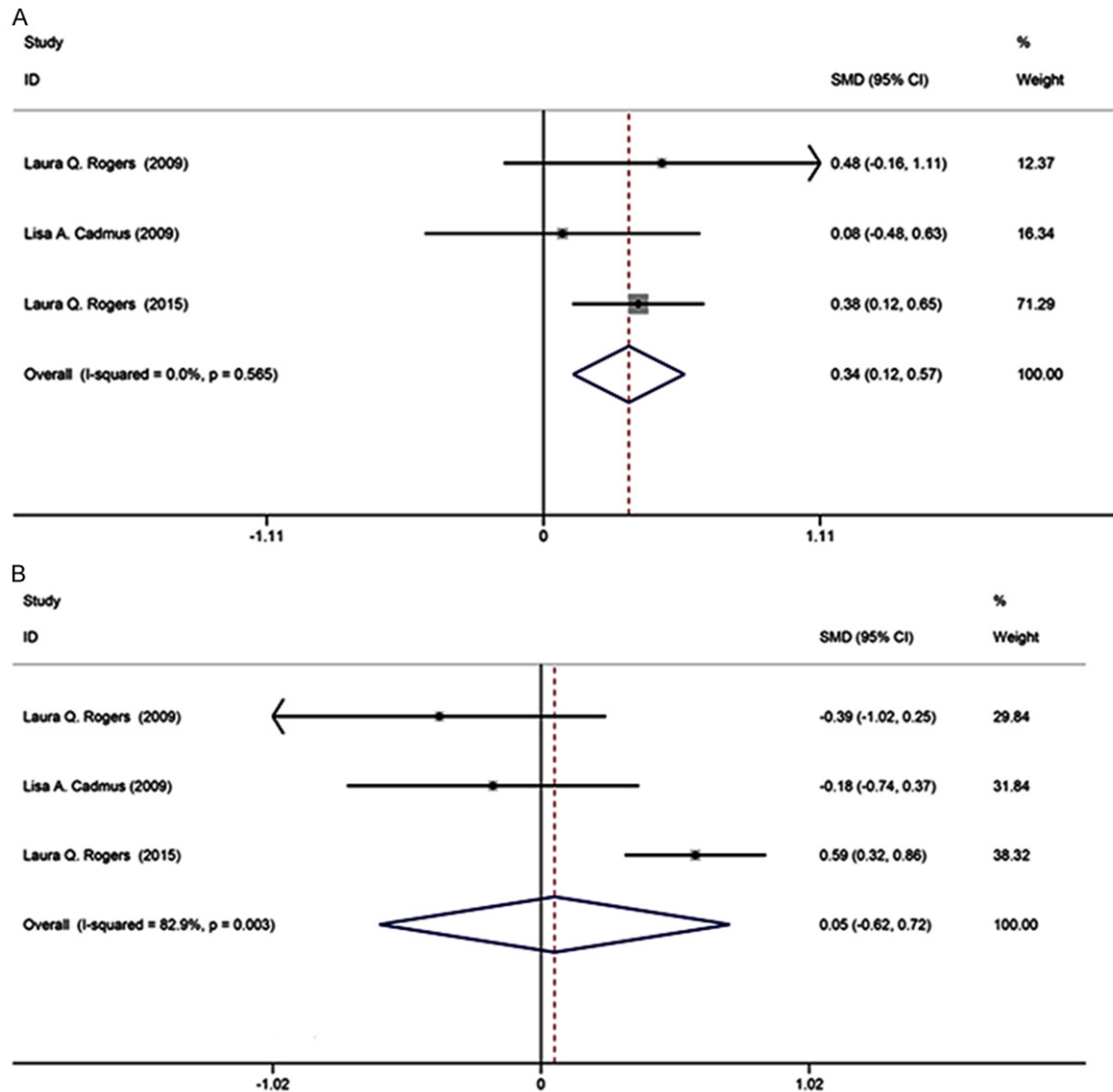
Figure 4. Forest plots of study evaluating the difference in the alterations of EWB (A) and FWB (B) between UC and home-based physical activity for survivors of ESBC.

-0.015 (95% CI: -0.430-0.400, **Figure 6**), and the value of *p* was larger than 0.05 (p = 0.945), which indicated that there was no significant difference in the alteration of FACT-F between the two interventions for survivors of ESBC.

Publication bias

The publication bias was appraised by Begg's test, and the Egger's test was used for further investigation. The relevant results were displayed in **Table 2**. For FWB, even if the value of *p* in Egger's test was 0.003, its value in Begg's test was larger than 0.05, and we still considered no significant publication bias for this

analysis. With respect to other parameters, the values of *p* in both Begg's test and Egger's test were larger than 0.05, signified no significant publication bias in these analyses.

Discussion

In this study, we performed the current meta-analysis to appraise the difference in the alterations of body composition, quality of life and fatigue between UC and home-based physical activity interventions for survivors of ESBC. For body composition, the results of BMI and percent body fat showed that no significant difference in the alteration of body composition

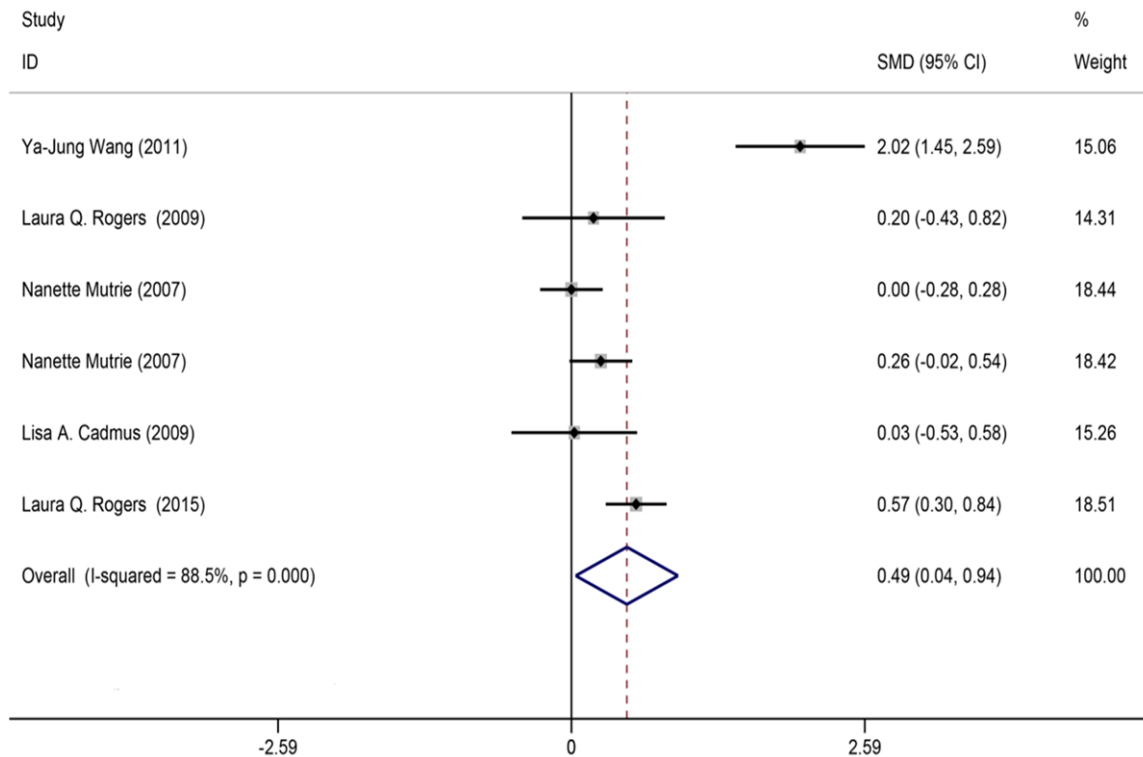# The effect of home-based exercise on ESBC survivors

Figure 5. Forest plot of study estimating the difference in the alteration of FACT-G between UC and home-based physical activity for survivors of ESBC.
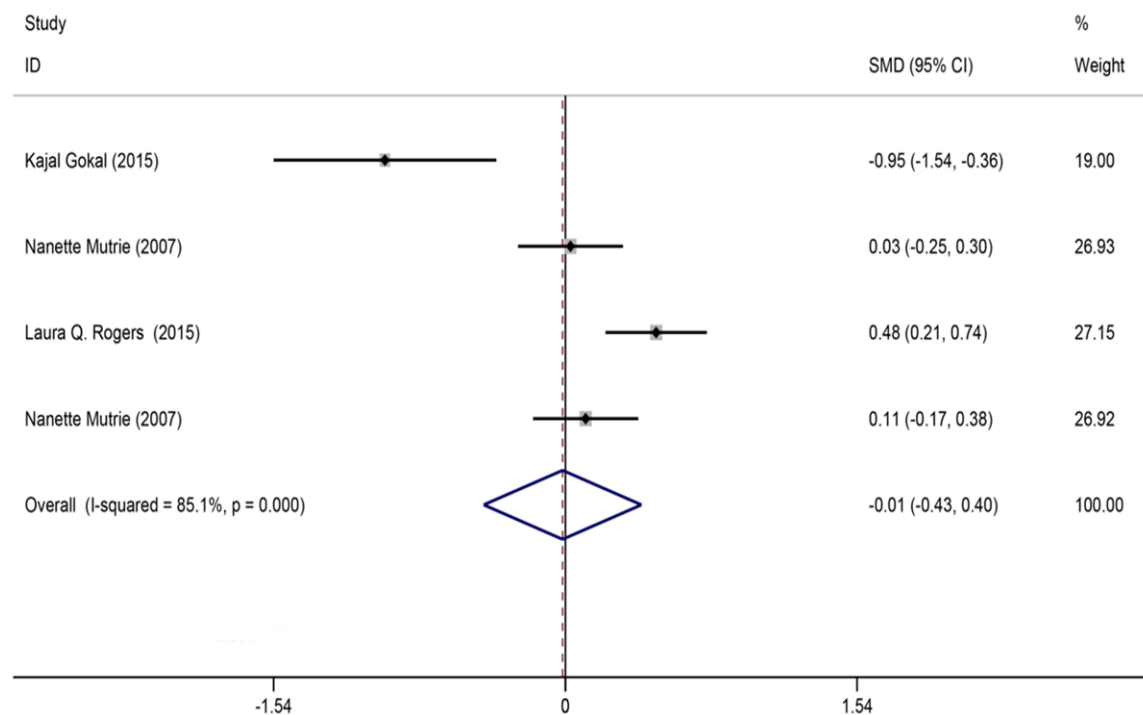

Figure 6. Forest plot of study assessing the difference in the alteration of fatigue between UC and home-based physical activity for survivors of ESBC.

between the two interventions was found for survivors of ESBC. In terms of the quality of life, the results of PWB, SWB, EWB, FWB and FACT-G suggested that compared with UC, the home-based physical activity intervention significantly improved the quality of life in survivors of ESBC. As for the fatigue, the results of FACT-F implied that the two interventions had similar effects on the fatigue in survivors of ESBC.

Breast cancer, which has the propensity to relapse after initial treatment, is a potentially life-endangering disease for millions of women [15-17]. The common treatment for patients with non-metastatic breast cancer involves surgery, adjuvant chemotherapy, radiation therapy or chemohormonal therapy [12]. Not only the endogenous and exogenous endocrine factors but also the genetic and environmental factors have been reported to be associated with the pathogenesis of breast cancer [18, 19]. During the last decade, the survival rates of ESBC have increased due to the early detection and more effective therapies for ESBC [20]. Previous studies have reported that ESBC survivors usually experience temporary, progressive, or permanent complications resulting from the disease itself, surgery, chemotherapy, radiotherapy, or hormonal therapy, which affects the quality of life for ESBC survivors [20]. In our study, we compared the effects of UC on the alterations of body composition, quality of life and fatigue to the home-based physical activity intervention, and observed that the home-based physical activity significantly improved quality of life for ESBC survivors but had no significant impact on the body composition and fatigue.

We used the 37-item FACT-Breast (FACT-B) to measure the quality of life for ESBC survivors, and the reliability and validity of the FACT-B for the estimation of quality of life have been confirmed by previous study [21]. The FACT-B includes the following five subscales: PWB, SWB, EWB, FWB and breast additional concerns (AC) [11]. FACT-G is the sum of PWB, SWB, EWB and FWB [10]. The FACT-F, containing 13 items, was used to evaluate fatigue in survivors of ESBC [10]. In our meta-analysis, compared with UC, the home-based physical activity interventioncan significantly improve the PWB, SWB, EWB and FACT-G, even if the FWB has no significant alteration after intervention. And we still believe that the quality of

life in ESBC survivors is significantly improved after home-based physical activity intervention, and the home-based physical activity should be recommended to ESBC survivors for improved quality of life.

Fatigue, one of the most prevalent symptoms in long-term cancer survivors, is a debilitating symptom experienced by patients with BC [22]. The treatment approaches for ESBC including surgery, chemotherapy, radiotherapy, and hormonal therapy have been documented to be correlated with increased fatigue [23]. A nested cohort study of 6,248 patients with ESBC suggested that chemotherapy-induced fatigue might be predictive for reduced survival rates and poor clinical outcomes for ESBC survivors [24]. It has been recorded that physical activity may improve fatigue for BC patients during and after treatment [23]. Gokal performed a randomized controlled trial and found that the home-based physical activity could significantly improve fatigue in ESBC survivors, compared with UC intervention [9]. However, study from Mutrie did not observeany significant improvement for fatigue after home-based physical activity intervention [14], which was consistent with the results in our meta-analysis. Our study with a larger sample size by incorporating all relevant data in case-control studies together has more reliable evaluation and implies that the fatigue in ESBC survivors is not improved by home-based physical activity intervention and it is necessary to develop more effective approaches to relieve fatigue.

Lahart conducted a meta-analysis to explore the correlation of physical activity and the recurrence and death of BC, and detected that appropriate physical activity might reduce mortality and BC events in BC survivors [25]. Another meta-analysis, incorporating relevant case-control studies from 2003 to July 2013, aimed to explore the effect of exercise on quality of life in survivors of BC, and revealed that the BC survivors had significantly improved overall quality of life after exercise intervention [26]. In our study, we searched studies published from the inception of databases to Dec. 31 2015 and defined strict inclusion and exclusion criteria. We included studies regarding to the effectiveness of UC and home-based physical activity interventions on health outcomes in ESBC survivors, and observed that compared with UC, although the home-based physical

activity intervention had no significant effect on the body composition and fatigue in ESBC survivors, the intervention significantly improved the quality of life for ESBC survivors.

To our knowledge, the present study is the first meta-analysis to evaluate the difference in the alterations of body composition, quality of life and fatigue between UC and home-based physical activity interventions among survivors of ESBC. However, some limitations exist. Firstly, though we only included ESBC survivors receiving UC and home-based physical activity interventions, the specific forms of home-based physical activity in the incorporated studies are not exactly the same, which may cause some bias. Secondly, we have not considered the unpublished literatures.

Taken together, the current meta-analysis suggests that compare with ESBC survivors receiving UC, those receiving home-based physical activity intervention are more likely to have improved quality of life. And patients with ESBC after treated with chemotherapy or/and radiotherapy should be recommended to have home-based physical activity.

Disclosure of conflict of interest

None.

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