Application effect of quality control circle in postoperative functional exercise compliance of breast neoplasms patients: a meta-analysis

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Abstract

Background: Good adherence to post-operative exercise is crucial for long-term exercise intervention programs aimed at improving compliance, motivation for functional exercise, and quality of life among breast cancer patients. This study aims to evaluate the application effect of quality control circles on postoperative functional exercise compliance in breast neoplasm patients. Methods: A comprehensive search was conducted in CNKI, Wanfang, VIP, CBM, PubMed, Cochrane Library, Web of Science and CINAHL databases from their establishment to May 06, 2023. Manual search and backtracking of relevant literature were also conducted. The search terms included a combination of subject terms and free words. Meta-analysis was performed using RevMan 5.4 software on eligible literature. Results: Initially, 517 papers were retrieved, and after removing duplicates 238 papers using NoteExpress software, 279 titles and abstracts were reviewed. Subsequently, 225 non-compliant papers were excluded, leaving 54 full texts to be read. After excluding 38 non-compliant papers, 16 eligible papers were included for Meta-analysis. These papers comprised a total of 1,342 patients (679 in the test group and 663 in the control group). The heterogeneity test using a fixed effects model showed $P = 0.22$ and $I^2 = 21\%$. The Meta-analysis results demonstrated that the implementation of quality control circles alongside usual care significantly improved compliance with postoperative functional exercise in breast cancer patients (odds ratio = 6.68, 95% confidence interval (4.97, 8.98), $P < 0.00001$). Conclusion: Quality control circles activities can effectively enhance compliance with post-operative functional exercise among breast cancer patients, aiding in the recovery of affected limb function, improvement of self-care ability, and early reintegration into society and normal life, thereby enhancing quality of life. It is important to continually accumulate experience in applying relevant quality control circles activities in clinical work and promptly enhance the level of care accordingly, as the functional exercise of breast cancer patients after surgery involves a long-term and gradual improvement process.

Keywords: quality control circle; breast cancer; postoperative functional exercise compliance; meta-analysis
**Background**

As people’s lifestyles change, the incidence of breast cancer in China has significantly increased in recent years. According to the Global Cancer Data 2020 statistics, female breast cancer has become the most common cancer globally and the fifth leading cause of cancer-related deaths worldwide [1]. In China, breast cancer ranks first in terms of incidence among female cancers and fourth in terms of mortality. It is estimated that one in eight women worldwide develops breast cancer, and only a small percentage, about 5–10%, have a genetic predisposition, while the majority, 90–95%, is influenced by environmental factors and lifestyle habits [2, 3]. Surgery is a common treatment for breast cancer [4]. However, post-operative patients often experience issues such as arm swelling, pain, and dysfunction, which significantly impact their physical and mental well-being and quality of life. Therefore, effective clinical interventions for postoperative breast cancer patients are crucial. Functional exercise should be initiated early after surgery to help patients alleviate edema, joint stiffness, and muscle atrophy in the affected limb, thereby improving functional impairments and other conditions. In recent years, the quality control circle has gained attention in clinical practice, offering a more comprehensive and targeted approach compared to conventional functional exercise measures used in the past [5]. Good adherence to post-operative exercise in breast cancer patients plays a vital role in implementing long-term exercise intervention programs, improving patient compliance with treatment, increasing motivation for functional exercise, and facilitating recovery.

The concept of quality control circle (QCC) was introduced by Dr. Shin Ishikawa in 1962. It involves the formation of voluntary groups comprising individuals from the same or similar workplace. QCC serves as a complement to the traditional top-down management model, encouraging more people to participate in solving workplace difficulties and problems by pooling their ideas and engaging in certain activities [4, 6, 7]. In the context of breast cancer, QCC can be utilized as a means to enhance the quality of the life for patients by promoting timely exercise and facilitating early recovery of affected limbs after surgery [8]. Research has demonstrated that the implementation of QCC activities in promoting functional exercise compliance among post-breast cancer patients can effectively improve the quality of care. This transformation from traditional passive care services to active care services can lead to improved limb function and ultimately enhance the patients’ quality of life [9].

Hence, the objective of this study is to establish a foundation for future nursing care by conducting a meta-analysis on the impact of implementing QCC on functional exercise compliance among postoperative breast cancer patients. The study seeks to enhance the quality of clinical care, increase patient satisfaction, and offer reliable clinical guidance regarding the role of QCC in promoting functional exercise adherence after breast cancer surgery.

**Methods**

**Inclusion and exclusion criteria**

**Type of study.** Case-control study or randomised controlled trial.

**Study participants.** 1. Patients diagnosed with breast cancer through pathological examination and operated in parallel. 2. Patients aged 18 years or older without significant comorbidities such as heart, liver, or kidney diseases.

**Intervention measures.** Test group, QCC nursing care; control group, conventional nursing care.

**Outcome measures.** Adherence to postoperative functional exercise.

**Exclusion criteria.** 1. Duplicate publications. 2. Studies without full-text availability. 3. Academic literature such as reviews, cases and conferences. 4. Studies with outcome measures that do not match the objectives of the research. 5. Studies without a control group.

**Retrieval strategy**

A comprehensive computerized search was conducted across eight databases, namely China National Knowledge Infrastructure, Wanfang, Weibo, CBM, PubMed, The Cochrane Library, Web of Science and CINAHL. The search covered the period from the establishment of the databases until May 6, 2023. In addition to the computerized search, a manual search and retrospective analysis of relevant literature were also performed. The search strategy involved a combination of subject terms and free words. For instance, in the Wanfang database, the search strategy used was: subject (breast cancer or breast tumor or breast carcinoma or breast lump) and subject: (quality control circle or quality control circle management or quality control circle activities or quality management circle or quality control circle or QCC). Taking Pubmed as an example for English retrieval: ("Breast Neoplasms" [Mesh]) OR (((Breast Tumors [Title/Abstract]) OR (Breast Cancer [Title/Abstract]) OR (Cancer of Breast [Title/Abstract]) OR (Breast Malignant Tumors [Title/Abstract])) OR (Breast Carcinoma [Title/Abstract]) OR (Summary Cancer [Title/Abstract])) AND ((quality control circle [Title/Abstract]) OR (quality circle [Title/Abstract]) OR (QCC [Title/Abstract])).

**Literature screening and data extraction**

Two researchers conducted independent screening of the literature, data extraction, and verification. In case of any disagreements, they consulted a third researcher to reach a consensus. The literature screening process involved using NoteExpress software to identify and remove duplicate articles. Then, the researchers evaluated the remaining articles based on their titles and abstracts to exclude those that clearly did not meet the inclusion criteria. Next, the full texts of the remaining articles were read and assessed strictly based on the predefined inclusion and exclusion criteria, resulting in the final selection of studies to be included. The data extraction process involved using an Excel spreadsheet to collect information such as the title, author, publication date, study type, sample size, intervention measures, and outcome indicators.

**Literature quality evaluation**

The two researchers assessed the quality of the included studies using the risk of bias assessment provided by the Cochrane Collaboration Network. The assessment items included the following: randomization allocation method, hidden allocation scheme, blind implementation, integrity of result data, selective reporting of results, and other sources of bias. Each item was evaluated for the likelihood of bias, categorized as “low risk”, “high risk” or “unclear”. The overall quality of the literature was divided into three levels: grade A, all criteria were met, indicating a low likelihood of bias; grade B, partially meeting the criteria, with a moderate likelihood of bias; grade C, none of the criteria were met, indicating a high likelihood of bias. In the case of any disagreements during the assessment, a decision was made through consultation with a third party.

**Statistical methods**

The meta-analysis was performed using RevMan 5.4 software. A statistical significance level of $P < 0.05$ was considered to indicate a significant difference. The odds ratio (OR) was chosen as the effect measure for the categorical data, and the effect sizes were presented with a 95% confidence interval (CI). Heterogeneity was assessed using the $I^2$ test. If no heterogeneity was observed ($P > 0.1, I^2 ≤ 50\%$), a fixed-effects model was employed. On the other hand, if heterogeneity was detected ($P < 0.1, I^2 > 50\%$), a random-effects model was utilized. In cases of substantial heterogeneity, sensitivity analysis was conducted to identify potential sources. If the source of heterogeneity could not be determined, only descriptive analysis would be performed. Publication bias in the literature was assessed using funnel plots.

**Results**

**Literature search results**

The initial search yielded 517 papers, 238 duplicates were eliminated.
using NoteExpress software, 279 titles and abstracts were read, 225 non-conforming papers were excluded, 54 full texts were obtained by reading the full text, 38 non-conforming papers were excluded, and 16 papers conforming to meta-analysis were finally included. See Figure 1.

Figure 1 Literature screening process and results

<table>
<thead>
<tr>
<th>Inclusion in the study</th>
<th>Sample size (cases)</th>
<th>Type of research</th>
<th>Interventions</th>
<th>Outcome indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test group</td>
<td>Control group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mei-Hua Gu 2015 [10]</td>
<td>29</td>
<td>26</td>
<td>Retrospective cohort study</td>
<td>Quality control circle nursing</td>
</tr>
<tr>
<td>Mei-Hong Li 2020 [12]</td>
<td>50</td>
<td>50</td>
<td>Retrospective cohort study</td>
<td>Quality control circle nursing</td>
</tr>
<tr>
<td>Yan Li 2018 [13]</td>
<td>18</td>
<td>18</td>
<td>Randomised controlled trials</td>
<td>Quality control circle nursing</td>
</tr>
<tr>
<td>Yu-Huan Li 2018 [14]</td>
<td>88</td>
<td>80</td>
<td>Randomised controlled trials</td>
<td>Quality control circle nursing</td>
</tr>
<tr>
<td>Ying Li 2014 [15]</td>
<td>41</td>
<td>41</td>
<td>Randomised controlled trials</td>
<td>Quality control circle nursing</td>
</tr>
<tr>
<td>Li Liu 2016 [16]</td>
<td>78</td>
<td>78</td>
<td>Retrospective cohort study</td>
<td>Quality control circle nursing</td>
</tr>
<tr>
<td>Liu Qian 2021 [18]</td>
<td>51</td>
<td>51</td>
<td>Retrospective cohort study</td>
<td>Quality control circle nursing</td>
</tr>
<tr>
<td>Xiong-Fei Mo 2019 [19]</td>
<td>41</td>
<td>36</td>
<td>Retrospective cohort study</td>
<td>Quality control circle nursing</td>
</tr>
<tr>
<td>Cui-Lian Tan 2014 [21]</td>
<td>35</td>
<td>33</td>
<td>Retrospective cohort study</td>
<td>Quality control circle nursing</td>
</tr>
<tr>
<td>Cai-Xiu Wu 2018 [22]</td>
<td>39</td>
<td>39</td>
<td>Randomised controlled trials</td>
<td>Quality control circle nursing</td>
</tr>
<tr>
<td>Shuang Zhang 2016 [23]</td>
<td>48</td>
<td>48</td>
<td>Retrospective cohort study</td>
<td>Quality control circle nursing</td>
</tr>
<tr>
<td>Fen-Shan Zheng 2016 [24]</td>
<td>60</td>
<td>60</td>
<td>Retrospective cohort study</td>
<td>Quality control circle nursing</td>
</tr>
</tbody>
</table>
Evaluation of the methodological quality of the included study literature

Of the 16 included papers: 1. 6 mentioned the method of random allocation [13–15, 17, 20, 22] and the rest did not. 2. Two were unblinded [18, 19] and the remainder were not mentioned. 3. The included studies were comparable. 4. Two of the trial group in one paper [14] withdrew from treatment and were lost to follow-up for personal reasons, the remaining 15 were not lost to follow-up. There was no selective reporting of outcomes. 6. No other sources of bias. The methodological quality assessment is shown in Figure 2.

Meta-analysis results

Adherence to postoperative functional exercise in both groups.

Sixteen papers [9–24] were included in the current study to investigate the effect of QCC on postoperative functional exercise adherence in breast cancer patients. These papers encompassed a total of 1,342 patients, with 679 in the trial group and 663 in the control group. Heterogeneity was assessed, yielding a test result of $P = 0.22$ and $I^2 = 21\%$. Consequently, a fixed-effects model was employed. The results demonstrated a significant improvement in compliance with postoperative functional exercise in the test group, with a statistically significant difference observed (OR = 6.68, 95% CI (4.97, 8.98), $P < 0.00001$). Please refer to Figure 3 for further details.

Differences in post-operative functional exercise adherence between the two randomised controlled trials.

Six papers [13–15, 17, 20, 22] in the current study examined the impact of a randomised controlled trial on postoperative functional exercise adherence in breast cancer patients using the pinocircle intervention. These papers included a total of 477 patients, with 237 in the trial group and 229 in the control group. Heterogeneity was assessed, resulting in a test outcome of $P = 0.36$ and $I^2 = 8\%$, indicating low heterogeneity. Therefore, a fixed-effects model was applied. The results from the analysis of the randomised controlled trials revealed a significant improvement in compliance with postoperative functional exercise in the trial group, with a statistically significant difference observed (OR = 4.90, 95% CI (3.05, 7.88), $P < 0.00001$). For more detailed information, please refer to Figure 4.

Figure 2 Results of the methodological quality assessment of the included literature.

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Experimental</th>
<th>Control</th>
<th>Odds Ratio</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weight</td>
<td></td>
<td>M.H. Fixed</td>
<td>95% CI</td>
</tr>
<tr>
<td></td>
<td>Weight</td>
<td></td>
<td>M.H. Fixed</td>
<td>95% CI</td>
</tr>
<tr>
<td>Cai et al. 2016</td>
<td>19</td>
<td>19</td>
<td>1.04</td>
<td>0.22</td>
</tr>
<tr>
<td>Chen et al. 2017</td>
<td>19</td>
<td>19</td>
<td>1.04</td>
<td>0.22</td>
</tr>
<tr>
<td>Qin et al. 2018</td>
<td>19</td>
<td>19</td>
<td>1.04</td>
<td>0.22</td>
</tr>
<tr>
<td>Wang et al. 2019</td>
<td>19</td>
<td>19</td>
<td>1.04</td>
<td>0.22</td>
</tr>
<tr>
<td>Total events</td>
<td>477</td>
<td>477</td>
<td>6.68</td>
<td>95% CI</td>
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<tr>
<td>Total events</td>
<td>477</td>
<td>477</td>
<td>6.68</td>
<td>95% CI</td>
</tr>
</tbody>
</table>

Figure 3 Meta-analysis forest plot of functional exercise adherence in the two groups after surgery. CI, confidence interval.

Figure 4 Meta-analysis forest plot of postoperative functional exercise compliance between subgroups of two randomised controlled trials. CI, confidence interval.
Differences in adherence to postoperative functional exercise between the two retrospective cohort studies. Ten papers [9–12, 16, 18, 19, 21, 23, 24] in the current study investigated the impact of a retrospective cohort study on postoperative functional exercise adherence in breast cancer patients using the QCC intervention. These papers involved a total of 876 patients, with 442 in the trial group and 434 in the control group. Heterogeneity was assessed, resulting in a test outcome of $P = 0.31$ and $I^2 = 14\%$, indicating low heterogeneity. Therefore, a fixed-effects model was applied. The analysis of the retrospective cohort studies revealed a significant improvement in compliance with postoperative functional exercise in the trial group, with a statistically significant difference observed (OR = 8.08, 95% CI (5.52, 11.82), $P < 0.00001$). For a more detailed depiction, please refer to Figure 5.

**Literature publication bias**

A funnel plot was constructed to assess publication bias in this meta-analysis, specifically focusing on compliance with postoperative functional exercise as the selected outcome indicator. The funnel plot exhibits a symmetrical distribution on both sides, indicating a low probability of publication bias. For a visual representation, please refer to Figure 6.

**Discussion**

Breast cancer surgery is a commonly employed treatment approach and plays a crucial role in comprehensive care for patients. Over the years, there has been a shift in surgical techniques from radical mastectomy to breast-conserving surgery, highlighting the evolving understanding of breast cancer biology and treatment philosophy [25]. The choice of surgical modality varies based on individual circumstances and has demonstrated effectiveness in improving survival rates and postoperative quality of life for breast cancer patients, making it a widely adopted practice in clinical settings. However, it is important to note that timely initiation of functional rehabilitation exercises following surgery is essential. Failure to engage in these exercises may lead to impaired function of the affected shoulder joint and have a detrimental impact on both the survival and quality of life of patients [12]. Therefore, it is crucial to emphasize the significance of postoperative functional rehabilitation to ensure optimal outcomes for breast cancer patients. The period of three to six months following radical breast cancer surgery is considered a critical phase for implementing functional rehabilitation exercises [26]. While traditional conventional functional exercises have shown some effectiveness in promoting functional recovery of the affected limb and preventing postoperative complications after radical breast cancer surgery, they still have limitations, such as slow functional recovery and a high incidence of complications [27]. Therefore, as the promotion of quality nursing care continues, it becomes imperative to understand the specific needs of breast cancer patients and enhance their compliance with postoperative functional exercises. This becomes a focal point for nursing quality management and an objective of continuous quality improvement. In the present study, we conducted a meta-analysis to evaluate the impact of implementing the QCC approach on functional exercise adherence among postoperative breast cancer patients. Our aim is to provide evidence-based findings that can support nursing practitioners in their provision of high-quality care. By doing so, we can enhance the overall nursing practice and ultimately improve the outcomes and well-being of breast cancer patients.

**Meta-analysis results of this study**

In our systematic evaluation, a total of 16 papers were meticulously selected and included based on strict adherence to the predefined inclusion and exclusion criteria. Through a comprehensive review of the literature and data collection, we conducted a meta-analysis to analyze the selected papers. The included studies provided detailed descriptions of the implementation methods and processes of the QCC intervention, and the outcome indicators were clearly defined. Among the included studies, there were 679 subjects in the experimental group and 663 subjects in the control group. Our analysis revealed that the application of QCC care, compared to conventional...
postoperative care for breast cancer, had a significant impact on improving patient compliance with postoperative functional exercise. The statistical analysis yielded a P-value of 0.22, indicating a statistically significant difference. This finding underscores the effectiveness of QCC care in enhancing patients’ adherence to postoperative functional exercise, thus emphasizing the importance of implementing this approach in clinical practice.

QCC can improve the compliance of postoperative functional exercise in breast cancer patients

In our study, we conducted a systematic evaluation of the QCC in improving post-operative functional exercise compliance in breast cancer patients. The results showed a significant improvement in compliance, which can be attributed to the effective management approach of QCC. QCC is a quality management team composed of workers from the same or complementary workplaces. They collaborate and brainstorm to address workplace issues, management challenges, and cultural aspects following specific activity procedures [28]. A review of the literature also supports the effectiveness of QCC in improving compliance with post-operative functional exercise in breast cancer patients through peer-to-peer cooperation. Several studies have highlighted the positive impact of QCC in this regard [9–24]. QCC adopts a holistic approach by integrating multiple measures, focusing on evaluation and feedback and making improvements based on them. This approach differs from conventional care and allows for a more organic and dialectical approach to improving patient outcomes. Overall, our study provides further evidence for the benefits of implementing QCC in the management of post-operative functional exercise in breast cancer patients. It emphasizes the importance of peer collaboration, evaluation, and continuous improvement to enhance patient care and outcomes.

Limitations and outlook of this study

1. Despite the rigorous process of literature screening and analysis, it is important to acknowledge the limitations of this meta-analysis. Language and other restrictions may have led to the omission of relevant literature, which could have impacted the comprehensiveness of the study. 2. The inclusion of 16 articles in this meta-analysis focused specifically on the impact of QCC care on postoperative functional exercise compliance. Although this allows for a focused analysis, it is important to note that a single outcome indicator was considered, which may limit the overall assessment of the intervention’s effectiveness. 3. The number of high-quality articles included in the meta-analysis was relatively limited, which may affect the overall quality of the literature. It is important to interpret the results with caution and consider the potential biases or limitations associated with the included studies. 4. The literature included in this study was predominantly in Chinese due to the limited availability of literature on the application of QCC activities in breast cancer patients from foreign countries. This language limitation may result in an incomplete representation of the research on this topic. 5. In nursing clinical practice, it is challenging to implement hidden, double-blind, and concurrent randomized controlled trials due to the nature of the work. Therefore, most of the included literature in this meta-analysis consisted of case-control studies, which may have influenced the overall quality of the Meta-analysis. There is a need for future research to focus on designing scientifically rigorous randomized controlled trials to further investigate the effects of QCC on postoperative functional exercise compliance in breast cancer patients. Conducting high-quality, large-sample, multicenter randomized controlled trials can enhance the quality and strength of the evidence and provide a solid basis for developing guidelines to guide clinical care practices.

Considering these limitations, it is essential to interpret the findings of this Meta-analysis with caution and encourage future research to address these gaps in order to improve the overall quality and generalizability of the evidence in this field.

Conclusion

In conclusion, QCC is feasible for significantly improving compliance with functional exercise after breast cancer surgery and can be promoted in clinical practice. However, it is important to note that the number of randomized controlled trials in the current study is small, and there is some clinical heterogeneity in the study population, interventions, outcome indicators, and diagnostic criteria. Additionally, the quality of the literature included in the study is not high, which affects the reliability of the article's results to some extent. Therefore, caution should be exercised when interpreting the results obtained from the Meta-analysis. To provide a more reliable basis, future studies should focus on conducting more high-quality, large-sample scientific studies to further validate the effects of applying QCC activities in postoperative functional exercise compliance, which can lead to earlier recovery and improve the quality of life of patients. Additionally, based on the improvement of the evidence level of each trial, the methods and care measures derived from the study to improve postoperative functional exercise compliance in breast cancer patients can be summarized and eventually published as guidelines for clinical practitioners. This study can also provide evidence for the implementation of QCC to improve postoperative functional exercise adherence of breast cancer patients in clinical practice, which can be used as a reference for quality managers in clinical practice.

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