EVIDENCE SYNTHESIS

Reliability, validity and feasibility of quality of life instruments for adult patients with cancer undergoing chemotherapy: result from a systematic review

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Abstract

Aim The aim of this review was to analyse the literature critically and present the best available evidence related to quality of life (QoL) instruments that consists of all four subscales of physical, psychological, social and spiritual, which can be used in the clinical setting to assess adult patients with cancer on chemotherapy.

Inclusion criteria This review included randomised control trials and observational studies without control group related to QoL instruments used for cancer chemotherapy. The types of participants for this review included all adults with cancer over the age of 18 years who have undergone chemotherapy. The QoL instruments for this review included instruments that consist of all subscales of physical, psychological, social and spiritual. In order to retrieve QoL instruments that were current and not outdated, this review included studies reported in the recent 10 years.

Search strategy A three-step search strategy was utilised to search for primary research articles published in the English language from January 1998 to December 2009. An initial search of MEDLINE and CINAHL was undertaken followed by analysis of the text words contained in the title and abstract, and the text terms used to describe the article. A second search strategy using all the identified keywords and the index terms was used for the 20 databases. The third search strategy was to search for additional studies from the relevant list of all identified articles.

Methodological quality The two independent reviewers appraised the included articles for methodological quality using the modified Elliot tool for reliability and validity.

Results A total of 3149 references was retrieved during the initial search. Only 13 articles with validation of the QoL instruments that contained all the four subscales of physical, psychological, social and spiritual were included in this review. Four QoL instruments were identified. These include the City of Hope QOL – Ovarian Cancer Tool (QOL-OVCA), QOL-Breast cancer version (QOL-BC), New India QoL tool and QoL Index-Cancer version (QLI-CV). Among the four identified QoL instruments, the frequency of assessment was more than once for QLI-CV, with intervals of 2 weeks to 6 months. Regarding the number of items, the QOL-BC instrument has the most number of items. All identified QoL instruments have content validity done. For reliability examination, all the identified QoL instruments have Cronbach's alpha of 0.7 and above for subscales. The correlation between subscales scores and overall QoL score was 0.53–0.93, 0.39–0.95 and 0.65–0.83 for QOL-OVCA, QOL-BC and QLI-CV, respectively.

Conclusion In this review, there was one article on development of new QoL instrument, the New India QoL tool, which has comprehensive validity examinations – the least number of items that may be useful in the clinical setting but need further psychometric testing in different settings or languages. The QLI-CV instrument has had comprehensive intra- and inter-method validation on different languages, different cultural settings and various types of cancer. However, the instrument may not be feasible because the method to calculate the QoL score is not straightforward.

Key words: cancer, chemotherapy, quality of life, reliability, validity.

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Background

Chemotherapy is one of the treatments that destroy cancer cells,[1] sometimes referred as 'anti-cancer' drugs or 'antineoplastics'. Chemotherapy act as biologic response modifiers, hormone therapy or monoclonal antibodies to treat cancer.[2] Chemotherapy can be prescribed as neoadjuvant or adjuvant. Neoadjuvant chemotherapy is prescribed prior to surgery to diminish tumour mass.[3] Adjuvant chemotherapy is prescribed post surgery to eliminate occult micrometastatic disease, hoping to increase disease-free survival.[4]

The use of chemotherapeutic agents for treatment of cancer has expanded widely with multiple potent agents being administered at higher but more tolerable doses.[2] The majority of these patients receive several cycles of chemotherapy over a period of months,[5] resulting in a toxic physiologic environment that causes adverse effects including fatigue, alopecia and potentially life-threatening neutropenia.[6–8] The incidence of adverse effects will continue to increase as more aggressive chemotherapy continues to be used more frequently.[9] These adverse effects of chemotherapy can be severe, such as anaemia,[10,11] neurological injury,[12] or cognitive decline[13] and may lead to a significant impact on the patients' quality of life (QoL).[14]

The World Health Organization defines QoL as an individual's perception of their position in life, in the context of the culture and values systems in their life, and in relation to their goals, expectations, standards and concerns.[15] It is a broad concept, incorporating a person's physical health, psychological state, level of independence, social relationships, personal beliefs and relationship to salient features of the environment.[15] Quality of life is intrinsic and subjective, which is influenced by the individual's personal values and life experiences.[16] Hence, measurement of QoL is to evaluate the patient's aspects of life including emotional, physical, functional, social, financial and spiritual status.[17] These factors are important to the individual as well as a society and are integral in describing overall QoL.[18] QoL instruments for patients with cancer that were developed before the 1980s, majority were focused on patients' functional status and emotional aspects.[17] For a decade, most experts in the QoL for oncology patients suggested that the subscales (domains) of the QoL instrument should be minimum, and the instrument should be multidimensional especially when it applies to health status.[17] The QoL instrument should be specific and relevant to the questions of interest in the patient's perception of illness and treatment, expectations of self and evaluation of illness, treatment risk or harm.[17] The experts considered the key subscales of the QoL should include physical (physical activities performance), psychological (anxiety or depression caused by illness or its treatment), social (perceived social support, maintenance of relationship and leisure activities) and spiritual (maintenance of hope and meaning of life despite illness).[17,19–21]

Although clinicians have long recognised the impact of chemotherapy on patient's QoL, the literature reports incorporating QoL measurements into routine clinical practice is a relatively new practice. Moreover, most oncology clinicians believe that if an appropriate instrument exists, subscales of the patient's QoL can be collected on a routine basis.[22] Being able to clinically evaluate the QoL of patients not only provides information about the impact of cancer and its treatment outcome, the information could be used to direct patient care, education and counselling in order to optimise patients' physical and psychological well-being.[23]

The number of published articles reporting QoL instruments used to evaluate patients with cancer undergoing chemotherapy has grown exponentially.[24,25] The instruments used range from short estimates of the patients' general status via non-validated ad hoc instruments, to more comprehensive measurements using validated instruments.[26] The QoL instruments commonly used in clinical trials were Ferrans and Powers QoL Index (QLI), Functional Assessment of Cancer Therapy scale (FACT), Functional Assessment Chronic Illness Therapy, Medical Outcomes Study Short Form Health Survey – 36, SF-12, The European Organization for Research and Treatment of Cancer QLQ-C30 (EORTC) and WHO Quality of Life-BREF (WHOQOL-BREF).

Prior to commencing of this systematic review, the Cochrane Library, Joanna Briggs Institute Library of Systematic Review, MEDLINE and the Database of Abstracts and Review were searched. Despite the amount of information regarding QoL instruments available in the literature, no previous systematic review on this topic, which examined QoL instruments that contain subscales of physical, psychological, social and spiritual psychometric properties, was identified. This systematic review aims to fill that gap.

The QoL instruments that encompass all four subscales of physical, psychological, social and spiritual for cancer patients were developed and published in the 1970s–1990s (the late twentieth century).[27] This systematic review intended to focus on studies reported in the recent 10 years, which used QoL instruments that consist of physical, psychological, social and spiritual for patients with cancer, in order to retrieve instruments that were current and not outdated.

This systematic review was undertaken to determine the reliability, validity and feasibility of QoL instruments for cancer patients. In this effort, the authors of this review hope to gather information to help clinicians when selecting a valid and reliable instrument for use in clinical practice. In addition, the instruments selected must be easy to use and interpret whilst not being a burden to clinicians or patients.[24]

Validity and reliability are necessary when assessing an instrument.[28] Validity is the accuracy of the instrument to measure what it claims to measure.[28,29] Validity of an instrument is assessed by establishing evidence about the structure and content of the instrument, factor analysis or statistical evidence of relationships between variables.[28] Content validity process is the evidence of content of the instrument being examined by experts in QoL or oncology, and cancer patients. Content of instrument that is examined by experts alone is considered incomplete validity.[29] Content validity also can be established by statistical analysis of relationships between variables, or factor analysis, or comparing the findings by using more than one QoL instrument to the

same groups of participants.[28,29] A weak relationship is when the correlation coefficients is 0.10–0.30, whilst correlation coefficients of more than 0.50 indicate a strong inter-instrument relationship.[28] When comparing with other instruments, validity is supported if there are similar changes in each participant's scores for both instruments.[28] Factor analysis examines correlations of variables within a set of items in the instrument. The items are considered acceptable and to be retained if the Eigenvalues of the factor analysis are greater than 1.0, which represent the amount of the total variance explained by these items.[30] Kaiser–Meyer–Olkin (KMO) and Bartlett's test of sphericity are tests to examine the adequacy of sampling.[30] Kaiser–Meyer–Olkin Values of 0.6 or above in the factor analysis are acceptable, and values that are closer to 1 are considered better.[30] Bartlett's test of sphericity is considered appropriate if $P < .05$.[30]

Reliability refers to the consistency and stability of the instrument to produce the same result on repeated measures.[28] Reliability of instrument is usually assessed by Cronbach's alpha or Guttman split-half to test for homogeneity; test–retest to test for stability; and inter-rater to test for equivalence. Cronbach's alpha is the most common statistical test of an instrument with Likert-type response levels.[28] Values of Cronbach's alpha between 0.7 and 0.9 indicate good reliability, and are excellent if above 0.9.[31] Guttman split-half reliability is to divide the instrument into half, and tests the consistency of the two divided sets of instrument items. The instrument is considered reliable if the correlation coefficients of the two sets of items are similarly equal.[28] Test–retest reliability is to test the consistency of the instrument on two or more separate occasions to the same participants.[29] These separate occasions' scores are compared and expressed as 'Pearson'.[28] Value of Pearson correlation that is above 0.70 is considered a reliable instrument. A reliability correlation of 0.89 or above indicates little measurement error of the instrument, 0.49 reflects a high measurement error and a correlation that is closer to zero reflects no significant relationship between two scores.[28,32] Feasibility was examined by the time taken to complete answering the instrument, number of items in the instrument, ease of use, method on calculation of scoring, language used, whether it needs translation.[33] This is important in the clinical setting to consider cost of training, language translation or manpower, and time.[29]

In this review, reliability analysis was categorised into intra- and inter-method reliability. Reliability analysis that examines the ability to produce similar results when applying two different QoL instruments, or same instrument but in different languages on the same population, was categorised as inter-method reliability in this review, which is more accurate.[34] Reliability analysis that examines the reproducibility of a QoL instrument, which is by applying single instrument to the same population at different time intervals in this review, was categorised as intra-method reliability.[34]

Objectives

The objective of this review was to analyse the literature critically and present the best available evidence related to QoL instruments that consist of all four subscales of physical, psychological, social and spiritual, which can be used in the clinical setting to assess adult patients with cancer on chemotherapy.

Questions to be answered were:

1 What are the available QoL instruments that can be used to assess adult cancer patients undergoing chemotherapy?
2 What are the reliability and validity of identified QoL instruments for adult cancer patients undergoing chemotherapy?
3 What is the optimal frequency of assessment using identified QoL instruments?
4 What is the feasibility of the use of identified QoL instruments by clinicians?

Criteria for considering studies for this review
Studies that met the following inclusion criteria were included in the systematic review:

Type of studies
This review included randomised control trials (RCTs) and observational studies without control group related to QoL instruments that contained all four subscales of physical, psychological, social and spiritual used for cancer chemotherapy.

Type of participants
This systematic review included all adults with cancer over the age of 18 years who have undergone chemotherapy.

Type of interventions
This review considered studies of QoL instruments that contained all four subscales of physical, psychological, social and spiritual used in conjunction with cancer chemotherapy.

Type of outcome measures
The primary outcomes included were:
• Number of QoL instruments used in conjunction with cancer chemotherapy
• Validity and reliability of the QoL instruments that consist of all subscales of physical, psychological, social and spiritual
• The types of measures or scale used, which consist of all subscales of physical, psychological, social and spiritual

The secondary outcomes included were frequency of assessment, and the suitability of the QoL instrument for use in the clinical setting. The suitability of the instruments to be included were to fulfil the following characteristics:[24]
• Short
• Easy to use
• Multidimensional
• Prospective design
• Not burdensome
• Easy to score and interpret
• Clearly defined end points
• Sensitive to changes in patient's health status

- Capable of international and cross-cultural standardisation
- Contain global questions regarding the cancer experience
- Captures cancer-specific morbidity
- Captures cancer treatment-specific morbidity
- Self-administered
- Standardised, reliable and valid
- Measures distress in addition to frequency and degree
- Captures baseline status and can be administered longitudinally

Search strategy

The search strategy aimed to find both published and unpublished studies in the English language only. A search strategy was developed to guide the systematic review. A three-step search strategy was utilised in each component of this review. An initial search of MEDLINE and CINAHL was undertaken followed by analysis of the text words contained in the title and abstract, and the text terms used to describe the article. A second search strategy using all the identified keywords and the index terms were undertaken across all included databases (Appendix I). The third search strategy was to search for additional studies, which were listed in the reference lists of all included articles.

To focus on the QoL instruments, which were developed in the recent 10 years that contained all four subscales of physical, psychological, social and spiritual, the following databases were searched 10 years preceeding from 1998 to 2009:
- CINAHL
- Biomedical Collection
- MEDLINE
- Embase
- Expanded Academic Index
- Ovid nursing
- PsycINFO
- PsycARTICLES
- APAIS Health and Austhealth On Informit
- Current Contents
- Social Science Citation Index
- Sociological Abstracts
- Cochrane Central Register of Controlled Trials (CENTRAL)
- Evidence-Based Medicine (EBM) Reviews – Health Technology Assessment
- EBM Reviews ACP Journal Club
- EBM Reviews Cochrane Central Register of Controlled Trials (CENTRAL)
  The grey literature search included:
- Digital Dissertations
- Mednar
- PsycEXTRA
- Australian Centre for Evidence Based Clinical Practice
- Clinical Medicine Netprints Collection (http://clinmed.netprints.org/collections/)

Every electronic database has its own indexing terms; search strategies were developed for each database although many of the terms used were the same. During the process of conducting the search, consideration was given to the diverse terminology used and the spelling of keywords as it might influence the identification of relevant studies. Experts in oncology QoL such as Dr Cheung Yin Bun were contacted regarding QoL research done in Singapore oncology population. Extensive hand-searching was conducted on journals such as Annals Academy of Medicine Singapore, Acta Oncologica, American Cancer Society, British Journal of Cancer, Clinical Therapeutics, Health and Quality of Life Outcomes, Journal of Clinical Epidemiology, Journal of Evaluation in Clinical Practice, Pharmacoeconomics, Quality of Life Research for published articles by Dr Cheung.

Methods of the review

Two reviewers independently reviewed the titles and abstracts based on the inclusion criteria identified after articles search. If the title and abstracts were inconclusive, full reports were retrieved, and thorough evaluation against the inclusion criteria was undertaken. The reference lists of all retrieved articles were further searched for additional references. The decision to include or exclude the study was undertaken by two independent reviewers. For data that was not clear from the trial report, attempts were made to obtain the data by contacting the authors. For example, the demographics of participants in articles reported by Vidhubala *et al.*[35] and Rustøen *et al.*[36] were sought by electronic mail to the authors to obtain the data.

Papers that have been published in duplicate were included only once. The decision for study eligibility was made by two reviewers and was checked by the third reviewer, who is an expert in the fields of oncology and systematic review.

Assessment of methodological quality

The standardised Joanna Briggs Institute (JBI) Meta Analysis of Statistics Assessment and Review Instrument critical appraisal tools for quantitative effectiveness studies were considered inappropriate for assessing studies reporting validity, reliability and feasibility of QoL instruments. Hence, the reviewers of this systematic review seek assistance from JBI Collaboration Support Unit (CSU). With the assistance of JBI CSU, a critical appraisal tool (Appendix II) was adapted from Elliot.[28] The appraisal tool used in this systematic review for assessing the quality of included studies was a modified version of the Elliot appraisal tool. Criteria numbers five and seven of the original version of Elliot[28] were removed by two reviewers, as the majority of included articles were not reporting on the process of development of the instrument.

The papers selected for retrieval were assessed by two independent reviewers for methodological validity prior to inclusion in the review using the modified Elliot[28] tool for reliability and validity (Appendix II). If there were disagreements between the reviewers, they were resolved through discussion, or with a third reviewer.

Data extraction

For this systematic review, a data extraction tool was developed (Appendix III) after reviewing and modifying from

other systematic review articles[37–39] that were published in the JBI Library. The data extracted included details about the authors, study design, population, QoL instrument, validity and reliability of the instrument, measure or scale of the instrument, and frequency of assessment, which related to the review questions.

Data on the type and language of instrument used, country of the study conducted, population and sample size were retrieved from the article. Data on validity analysis, such as content validity, were retrieved when available. Data of reliability analysis on total or subscales' Cronbach's alpha were retrieved from the article if available. Data of feasibility on the number of items content in instrument, time spent to answer the questionnaire and response rate were retrieved when available.

Data synthesis

The studies included in this review were quantitative papers. The results were present as a narrative summary of the results. Validity, reliability and feasibility data of the QoL instruments were presented in table form (Table 1). Each paper was analysed separately.

Review results

Description of studies

The search yielded 3149 references from 20 databases. The search from citations in the included articles yielded 45 additional references. The two reviewers, after eliminating 518 duplicate articles, independently assessed the remaining 2676 articles' titles and abstracts against the inclusion criteria of this review (Appendix I). Two thousand five hundred and fifty-nine articles were excluded because these articles were non-research articles, or the study populations of these articles were non-cancer adult patients. The remaining 117 articles that met the inclusion criteria were included for full text examination. Ninety-two articles were excluded because the QoL instruments used in the studies did not contain all four subscales of physical, psychological, social and spiritual. The remaining 25 articles, which used QoL instruments that contained all the four subscales on participants with cancer chemotherapy, were assessed on whether validity or reliability examinations of the QoL instruments were performed by the authors. As a result, another 12 articles were eliminated (Fig. 1). A total of 13 articles were included in this review, and the methodology used to validate the QoL instruments were appraised using the modified version of the Elliot appraisal tool (Appendix II).[28]

The list of excluded articles is provided in Appendix IV. The reasons for exclusion are either the instruments did not contain the four subscales or the instruments were used to measure treatment effect of cancer treatment/disease process without performing validation examination of the instrument. The sample sizes of these included articles ranged from 27 to 1383. Four articles reported having a small sample size of below 60,[42,43,45,50] eight articles reported having medium sample size of 101–400 participants,[35,36,41,44,46–49] and one article reported large

sample size of 1383.[40] The majority of the articles did not reveal the sample power strength except for articles by Freihat and Ebert.[42,48] Five of the articles included in this systematic review were focused on breast cancer population.[41,42,46–48] One study was focused on prostate cancer population,[44] another on ovarian cancer[40] and the rest were a mixture of cancer types.[35,36,43,45,49,50] Three articles did not mention types of cancer treatment received by the studies' sample.[35,36,50]

Methodological quality

Among the 13 included articles, 3 were RCTs,[41,43,50] 2 were longitudinal studies without control group[36,45] and 8 studies were cross-sectional studies.[35,40,42,44,46–49] Though 3 articles were RCT, 2 were conducted on a small sample size of less than 55 participants, which might affect the study's outcomes.[51,52]

In this review, there was one article on development of new QoL instrument;[35] the other 12 included articles performed validation examinations on the original or translated versions of three developed QoL instruments. Majority of these included articles only performed intra-method reliability assessment of the QoL instruments. There were three articles that performed both intra-method and inter-method reliability assessment of the QoL instruments, which were more comprehensive.[36,40,49] These articles were comparing the instrument with the original language versions of QoL instruments[36,40] or comparing with QoL instrument in different languages.[49]

Among the 13 included articles, only 4 articles reported validity examinations of content validity, or factor analysis of the QoL instruments.[35,40–42] Of these 4 articles that reported validity examinations of QoL instruments, only Vidhubala[35] conducted comprehensive validity examinations of factor analysis and content validity by both experts and patients.

Results

Available QoL instruments identified

There were a total of four QoL instruments identified from these included articles (Table 2). All of the instruments were self-administered questionnaires. The identified instruments include City of Hope QOL – Ovarian Cancer Tool (QOL-OVCA), QOL-Breast cancer version (QOL-BC), New India QoL tool and QoL Index-Cancer version (QLI-CV). Instruments vary considerably in subscales, cancer specific and length. Although all the QoL instruments included in this review consist of all of the four subscales of physical, psychological, social and spiritual, the psychological and spiritual subscales were grouped as one subscale in the QLI-CV. The numbers of items (questions) in these QoL instruments range from 36 to 70 items.

Reliability and validity of identified QoL instruments

QOL-OVCA

The QOL-OVCA was adapted from the City of Hope four-dimensional QoL instrument by Ferrell and associates,[53–57]

Table 1 Systematic review data extraction of the 13 included articles

Author (years)	Type and version of QoL instruments used	Study design	Population	Sample size	Validity	Reliability Intra-method	Inter-method	Feasibility	Frequency of assessment	Author's conclusion	Reviewer's conclusion
Ferrell et al. (2005)[40]	City of Hope QOL Ovarian Cancer Tool, English version	Cross-sectional	Ovarian cancer patients	1383	Factor analysis: a four-factor solution was identified	■ Coefficient alphas: physical well-being = 0.8 psychological well-being = 0.91 social well-being = 0.78 spiritual well-being = 0.7 overall QoL = 0.92 ■ Correlation coefficient (r): among subscales' scores: 0.16–0.71 between subscales scores and overall QoL score: 0.53–0.93	Cronbach's alpha of each subscale was similar to generic version of the instrument	■ No mention of time spent to answer the questionnaire ■ 45 items with score range from 0 to10: 0 (worst outcome), 10 (best outcome)	Once	■ Has high coefficient alphas that compared favourably with the generic QoL instrument ■ Correlation coefficients among the four subscale scores indicating <50% overlap in variance between scores ■ Moderate to high correlation between subscale scores and overall QoL scores. Subscale scores are significantly and positively correlated with a single QoL item at the moderate level. ■ Items related to the 'childbearing segment of the life cycle' should be removed from future versions of the tool, and items on 'survivorship guilt' was not well understood by the respondents.	■ High internal consistency ■ No validity done
Ferrell et al. (1998)[41]	QOL-Breast cancer version (QOL-BC), English version	RCT	Breast cancer patients	298	Content validity by oncology experts of researchers and nurses	Pearson's correlation between total QoL and subscales of: psychological = 0.95 social subscale = 0.86 physical subscale = 0.74 spiritual subscale = 0.39	Nil	■ No mention of time spent to answer the questionnaire ■ 47-item scale of 0 (worst outcome) to 10 (best outcome)	Once	■ Strong correlation between total QoL and variables of physical symptoms (e.g. fatigue and pain); spiritual well-being (e.g. uncertainty and the importance of spiritual support) ■ Seventeen variables were statistically significant in predicting overall QoL, which account for 91% of the variance in overall QoL. ■ Findings on variance in relation to the three age strata (younger than 40 years, 40–60 years and older than 60 years) were consistent with previous research reports. Symptoms specific to breast cancer treatment (e.g. menstrual changes, vaginal dryness and fertility concerns) may influence the quality of survivorship.	■ Strong positive association between the total QoL and subscales except the spiritual subscale. ■ The findings on the in-depth interview with breast cancer survivors were not reported in this study report.
Ebert (2006)[42]	QOL-BC, English version	Cross-sectional	Breast cancer patients	60	Content validity by nursing oncology experts	■ Test–retest reliability after 2 weeks: overall = 0.89, physical subscales = 0.88 psychological subscales = 0.88 social subscales = 0.81 spiritual subscales = 0.90 ■ Cronbach's alpha: overall = 0.94 physical subscales = 0.81 psychological subscales = 0.92 social subscales = 0.75 spiritual subscales = 0.64	Nil	■ 20–30 min to complete three instruments ■ 46 items on 0–10 Likert scale: 0 (worst outcome) to 10 (best outcome) ■ 31 of the 46 items are reverse scored.	Once	Cronbach's alpha was similar to other previously reported internal consistency.	■ Small sample size ■ Moderate to high internal consistency ■ High test–retest reliability

Author	Instrument	Design	Population	Sample		Validity	Reliability		Timing	Questionnaire details	Comments	Strengths/limitations
Vidhubala et al. (2005)[35]	New India QoL tool, English version	Cross-sectional	Cancer patients	400	Nil	Content validity by 18 experts in medical and psychological fields: Relevance: 81–100% Clarity: 63–100% Comprehensiveness to the globally applied QoL concept: 100% Pilot study on 30 patients Factor analysis: Kaiser–Meyer–Olkin = 0.83, Bartlett's test of Sphericity: adequate, $P = 0.00$ Eigenvalues of all the factors: 8.55–1.10, accounted for 62.6% of variance	■ Cronbach's alpha overall = 0.90 ■ Guttman split-half reliability = 0.74	Nil	Once	■ No mention of response rate ■ 12–15 min to complete the questionnaire ■ 38 items on 4-point Likert scale: 1(very much), 4 (not at all); ■ 16 items of direct scoring, 22 items of reverse scoring	■ Content and factorial validity of the instrument were established. ■ The instrument was less time consuming and is feasible to use in a busy setting. ■ Study only in one centre and culture	■ 26 (6.5%) of the samples were removed due to outlier or extreme values. ■ Comprehensive validity and reliability of instrument with strong validity and reliability ■ Newly developed instrument specifically for Indian scenario ■ Study only in one centre and culture. The instrument has the fewest items. ■ Items related to the social subscale were split into other factors labels (e.g. self-sufficiency and independence, interpersonal relationship, external support and mobility). ■ No mention of: The response rate The proportion of sample's gender
Wickham (1998)[43]	Quality of Life Index-Cancer version (QLI-CV), English version	RCT	Lung/breast/head and neck cancer patients	52	Nil	Nil	Cronbach's alpha (24 h after first cycle of chemotherapy): overall = 0.94 health and functioning subscale = 0.91 socioeconomic subscale = 0.75 psychological/spiritual subscale = 0.86 family subscale = 0.68	Nil	Eight time points at: before chemo, 24 h post chemotherapy, daily from day 3 to day 8; by interview and self-administered questionnaire	■ 10 min to complete the questionnaire ■ 34 matched items for satisfaction and importance (total of 68 items) ■ 6-point Likert scale, higher score indicate higher QoL.	■ RCT ■ Small sample size ■ Cronbach's alpha were similar to other previously reports.	■ RCT ■ Small sample size ■ 80.8% was breast cancer patients ■ Both groups had similar baseline characteristics ■ Moderate to high internal consistency ■ No validity test done ■ The psychological and spiritual subscales were combined unlike other instruments where it is presented/captured as an explicit QoL subscale

Table 1 Continued

Author (years)	Type and version of QoL instruments used	Study design	Population	Sample size	Validity	Reliability Intra-method	Reliability Inter-method	Feasibility	Frequency of assessment	Author's conclusion	Reviewer's conclusion
Harrington et al. (2009)[44]	QLI-CV, English version	Cross-sectional	Prostate cancer patients	132	Nil	Reliability coefficients (without items 21 and 22 which were employment related) overall scale = 0.95 health an functioning subscales = 0.91 social and economic subscales = 0.77 psychological/spiritual subscales = 0.93 family subscales = 0.77	Nil	■ No mention of time spent to answer the questionnaire ■ 33 matched items for satisfaction and importance (total of 66 items) on a 6-point Likert scale ■ Scores from 0 to 30 with higher scores indicating more satisfactory QoL ■ Large amount of missing data and inconsistent pattern of response for two items related to employment	Once	To include body image assessment in QoL instrument	■ No mention of time spent to complete the questionnaire ■ High internal consistency ■ No validity test done ■ Large amount of missing data and inconsistent pattern of response for two items related to employment
Hanchett (2001)[45]	QLI-CV, English version	Longitudinal	Cancer patients	27	Nil	Variance testing scores of: social and economic: $F = 32.2$, $P = 0.002$ health and function: $F = 0.657$, $P = 0.771$ psychological/spiritual: $F = 2.365$, $P = 0.21$ family: $F = 1.03$ $P = 0.479$ overall scores: $F = 3.794$, $P = 0.149$	Nil	■ No mention of time spent to answer the questionnaire ■ 33 matched items for satisfaction and importance (total of 66 items) with Likert scale of 1–5, total score of 0–30	Twice: first week of admission and 4 weeks later	■ Stability of overall QLI scores is consistent with the findings of other QoL researchers who have repeated surveys during a 4- to 8-week time period. ■ Significant difference in the subscale scores of social and economic, no significant difference of variance testing in the subscales scores of health and function, psychological/spiritual, family and overall scores. QLI-CV is not specific or sensitive to treatment or type of service. ■ No predictable correlation between physical health, activities of daily living and overall QoL ratings.	■ Small sample size ■ No mention of time spent to answer the questionnaire ■ Reliability test – only social and economic subscale is significant ■ No validity test done
Sammarco (2001)[46]	QLI-CV, English version	Cross-sectional	Breast cancer patients	101	Nil	Alpha coefficient: Overall scale = 0.95 health and functioning subscale = 0.86 socioeconomic subscale = 0.81 psychological/spiritual subscale = 0.96 family subscale = 0.82	Nil	■ No mention of time spent to answer the questionnaire ■ 35 matched items for satisfaction and importance (total of 70 items) on a 6-point Likert-type scale, scores range from 0 to 30; higher scores denote greater perceived QoL	Once	■ Most of the correlations reported were low to moderate, although they were statistically significant. ■ Items in the Social Support Questionnaire (SSQ) referring to family relationships could have influenced responses in the QLI-CV family subscale, especially if the participants answered the SSQ first.	■ No mention of time spent to answer the questionnaire ■ High internal consistency

Author	Instrument	Design	Population	N	Validity	Reliability	Comparison	Administration / scoring	Frequency	Findings / Comments
Sammarco (2003)[47]	QLI-CV, English version	Cross-sectional	Breast cancer patients	103	Nil	Cronbach's alpha: entire instrument = 0.97; health and functioning subscale = 0.88; socioeconomic subscale = 0.78; psychological/spiritual subscale = 0.90; family subscale = 0.79	Nil	No mention of time spent to answer the questionnaire; 35 matched items for satisfaction and importance (total of 70 items) on a 6-point Likert-type scale, scores range from 0 to 30	Once	▪ Most of the correlations with other instruments reported were low to moderate, although they were statistically significant. ▪ Items in the SSQ referring to family relationships could have influenced responses in the QLI-CV family subscale. / ▪ No mention of time spent to answer the questionnaire ▪ High internal consistency ▪ No validity test done
Freihat (2005)[48]	QLI-CV, Arabic version	Cross-sectional	Breast cancer patients	102	Nil	Cronbach's alpha entire instrument = 0.98	Nil	40 min to complete four sets of survey instruments; 33 matched items for satisfaction and importance (total of 66 items) each on a 6-point Likert scale: 1 (very satisfied/very important), 6 (very dissatisfied/very unimportant). Total score ranges from 0 to 30. Higher score indicates higher QoL	Once	▪ The instrument has high internal reliability with real world application. ▪ The instrument retained high internal consistency when translated into Arabic. ▪ 4.5% of participants who did not complete the survey stated that it would be emotionally difficult to complete the study questions (age 35–42 years). ▪ The mean score of the QoL was lower than previous studies; it may be due to cultural and people's values differences. / ▪ Dropout rate of 4.5% ▪ High internal consistency in Arabic version ▪ Only perform Cronbach's alpha on entire instrument, but not on subscales ▪ No validity test done ▪ Mean score not consistent with other previous studies
Rustøen et al. (1999a)[36]	QLI-CV, Norwegian version	Longitudinal	Cancer patients	131	▪ Content validity by a QoL research knowledgeable person. ▪ Pilot study with 14 cancer patients ▪ Construct validity: eight factors emerged with Eigenvalues >1	▪ Test-retest (r): entire instrument = 0.78; subscales = 0.65–0.83. ▪ Cronbach's alpha: entire instrument = 0.93; subscales = 0.79–0.88. Retest for entire instrument = 0.95 ▪ Subscales = 0.82–0.91 ▪ Inter-correlation between psychological/spiritual subscale and: family = 0.53; health and functioning = 0.73 ▪ Correlation between total scale and: health and family = 0.74; psychological/spiritual = 0.75; socioeconomic = 0.76	Compared with the original version: ▪ The four-factor solution explained only 45.4% of the variance. ▪ Similar correlations between the factor scores and the subscale scores ▪ Lower test-retest reliability ▪ Similar high Cronbach's alpha	21% dropout; 10–15 min to complete the questionnaire; 34 matched items for satisfaction and importance (total of 68 items) on a 6-point Likert scale, scores ranges from 0 to 30, higher score indicates better QoL	Twice with interval of 3–4 weeks	▪ No significant difference between the dropouts and the rest of the sample in age, gender, type of cancer and level of QoL. ▪ Internally consistent with satisfactory test–retest reliability and face validity ▪ The four-factor solution explained only 45.4% of the variance versus 91% reported by Ferrans and Powers. All subscales were correlated with each other and with the entire instrument, except family subscale. ▪ The family subscale was the least stable subscale from test to retest. ▪ The QLI represents a universal formula that applies across different disease categories but not sensitive enough to differentiate between different groups. / ▪ High dropout rate ▪ 76% of participants were female ▪ 55% of participants were with breast or gynaecological cancer ▪ Intra- and inter-method of reliability were performed. ▪ Comprehensive validity test ▪ Unstable psychological/spiritual and family subscales

Table 1 Continued

Author (years)	Type and version of QoL instruments used	Study design	Population	Sample size	Validity	Reliability Intra-method	Reliability Inter-method	Feasibility	Frequency of assessment	Author's conclusion	Reviewer's conclusion
Rustøen et al. (1999b)[49]	QLI-CV, Norwegian version	Cross-sectional	Cancer patients	131	Nil	Cronbach's alpha at: test = 0.93 retest = 0.95 Test–retest correlation (Pearson's) at 3–4 weeks: $r = 0.78$	Mean score of 21.46 similar to other versions of QLI, mean of 20.7–22.3	10–15 min to complete the questionnaire 34 matched items for satisfaction and importance (total of 68 items) on 6-point Likert scales, total score range from 0 to 30, high score indicates better QoL	Once	▪ Lack of heterogeneity in the cancer diagnoses and prognostic factors of the study sample ▪ The instrument is suitable for cancer patients. ▪ No differences in QoL psychological and sexual subscales found with different types of cancer. ▪ Small differences in overall QoL between the different types of cancer or between the time elapsed since diagnosis ▪ Sensitivity and/or relevance of QLI was doubtful with very small differences observed between the healthy individuals and various patient groups.	▪ 56% of participants were with breast or gynaecological cancer ▪ 76% of participants were female ▪ No validity test done ▪ Intra- and inter-method of reliability were performed. ▪ High internal consistency ▪ High test–retest correlation ▪ Consistent mean score with other previous studies ▪ The doubtful sensitivity and/or relevance of the instruments reported by other previous studies may be due to their small sample size in these previous studies.
Rustøen et al. (2000)[50]	QLI-CV, Norwegian version	RCT	Cancer patients	41	Nil	Test–retest correlation coefficient – unstable items of QoL: family subscale: family's health $r = 0.35$, 0.68, 0.22 family's happiness $r = 0.68$, 0.70, 0.23 relationship with spouse $r = 0.61$, 0.5, 0.01 health and functioning subscale: your health $r = 0.53$, 0.70, 0.30 psychological/spiritual subscale: peace of mind $r = 0.71$, 0.39, 0.27 socioeconomic subscale: emotional support from others $r = 0.71$, 0.51, 0.31	Nil	▪ Response rate of 28.2%. ▪ No mention of time spent to answer the questionnaire. 34 matched items for satisfaction and importance (total of 68 items) on 6-point Likert scales, total score range from 0 to 30, high score indicates better QoL.	Four times during a 9-month period: 3–4-week interval between test 1 and test 2, 8 weeks between tests 2 and test 3, and 6 months between test 3 and 4.	▪ The correlations between the importance of individual items were only moderate. ▪ Items of family subscale were quite unstable. ▪ Items of family subscale were unstable especially at 9 months, r ranged from 0.01 to 0.70. ▪ Most unstable items tended to become less important over time.	▪ Low response rate ▪ Small sample size ▪ 66% of participants were with breast and gynaecological cancer. ▪ 76% of participants were female. ▪ No mention of time spent to answer the questionnaire ▪ No validity test ▪ 1–3 items of all subscales were unstable over 1–6 monthly intervals.

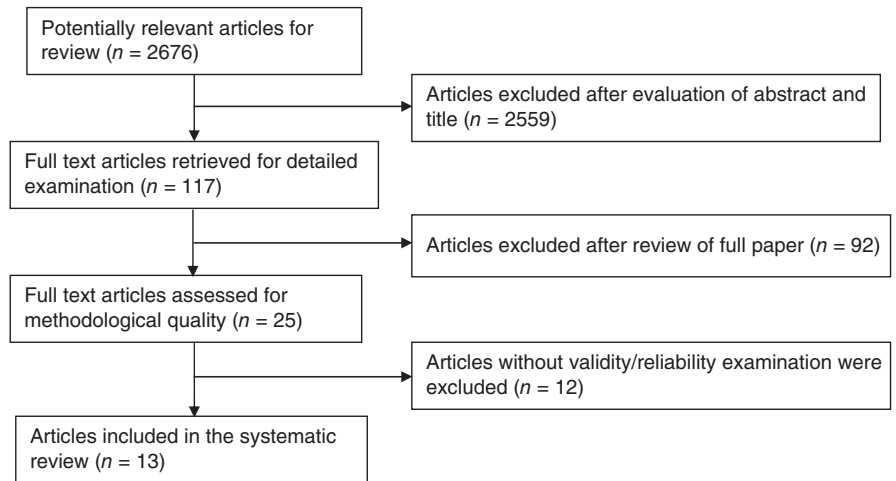QoL, quality of life; RCT, randomised control trial.

Figure 1 Flowchart of the stages of searching and inclusion/exclusion of the references for the review

using qualitative data from more than 20 000 pieces of correspondence written by women with ovarian cancer. The instrument is ovarian cancer specific. Thirty-one of the 46 items are reverse scored. There was one study included in this review which validates the QOL-OVCA instrument (Table 2).[40]

Validity. Factor analysis was performed for construct validity, with a four-factor solution identified, which confirmed the instrument is multidimensional.

Reliability – intra-method validity. Reliability examination was conducted on 1383 ovarian cancer patients. The Cronbach's alpha of each subscale was 0.70 and above. The correlation coefficient among the four subscales scores ranged from 0.16–0.71. Correlation between each subscale score and overall QoL score ranged from 0.53–0.93. Items of 'childbearing segment of the lifecycle' and 'survivorship guilt' have item–total correlation of less than 0.20.

Reliability – inter-method. The Cronbach's alpha of each subscale was 0.70 and above, which was similar when compared with the generic version of the instrument (Table 2).

QOL-BC
The City of Hope QOL instrument was developed by Hassey-Dow and Ferrell.[58] The QOL-BC was adapted from the QOL-Cancer Survivors Scale and designed by the research of Hope Center of California, for assessing the QoL in women with breast cancer.[58–61] This questionnaire originally included 46 items on a scale of 0–10; the lower the total score, the better the QoL. There were two studies included in this review,[41,42] which performed validation of the QOL-BC on patients with breast cancer (Table 2). Ebert's study[42] was a cross-sectional study on a convenience sample, whereas Ferrell's[41] was an RCT.

Validity. Both authors reported examination of content validity of the QOL-BC by experts in nursing oncology. In addition, content validity by a panel of QoL researchers was reported by Ferrell.[41]

Reliability – intra-method. Ferrell[41] performed correlation analysis between total QoL and subscales. Ferrell[41] found that there was a high correlation between total QoL (Pearson's $r = 0.89$) and subscales of psychological, social and physical (Pearson's $r = 0.95–0.74$) except for spiritual subscale ($r = 0.39$). Ferrell[41] reported that multiple regression was performed, and 17 variables of the instrument, such as control, pain, uncertainty, satisfaction, future, appearance and fatigue were found to be statistically significant, which account for 91% of the variance in overall QoL. The findings of greater distress and life disruption on younger women with breast cancer by Ferrell[41] were consistent with previous research report as cited by the author. Ebert[42] performed Cronbach's alpha and test–retest reliability assessment on the same instrument. The Cronbach's alpha reported by Ebert[42] was 0.94 for the overall instrument, 0.81, 0.92, 0.75 and 0.64 for subscales of physical, psychological, social and spiritual, respectively. Ebert[42] also reported high test–retest reliability for the overall QoL and the subscales, which ranged from 0.90–0.81.

New India QoL Tool
In this review, there was only one study reported on the development of the new QoL instrument (Table 2).[35] The New India QoL tool was developed by Vidhubala and tailored to Indian patients with cancer.[35] The items included in this instrument were drawn from literature, the WHO-QOL-100, EORTC, the Indian QOL general instrument and other QoL instruments. The New India QoL tool comprises 10 factors consisting of 38 items. There is only one item on belief (spirituality), which is listed under the subscale labelled optimism and belief.

Validity. The New India QoL tool was validated using a convenience sample that involved all types of cancer. Content validity assessment and principal component method assessment were performed to examine the validity of the instrument. The content was examined by a pilot study on 30 patients, and 18 medical and psychological

Table 2 Summary of review results

QoL instruments	Number of studies	Validity and reliability			Feasibility		Frequency of assessment
		Validity	Reliability		Number of items	Time spent to answer	
			Intra-method	Inter-method			
City of Hope QOL Ovarian Cancer Tool	1[40]	■ Factor analysis: a four-factor solution was identified	■ Cronbach's alphas: – Subscales: ≥0.7 ■ Correlation coefficient: – Among subscales: 0.16–0.71 – Between subscales and overall QoL: 0.53–0.93 ■ Item–total correlation < 0.2 for 2 items of: 1. Childbearing segment of the lifecycle 2. survivorship guilt	■ Cronbach's alphas of each subscale were similar to generic version	45	No mention	1 time
QOL-Breast cancer version	2[41,42]	■ Content validity by oncology experts of researchers[41] and nurses[41,42]	■ Pearson's correlation between total QoL and subscales: 0.39–0.95[41] ■ Multiple regression:[41] 17 variables account for 91% of the variance in overall QoL ■ Test–retest reliability:[42] – Overall QoL and subscales: 0.81–0.90 ■ Cronbach's alphas:[42] – Overall QoL: 0.94 – Subscales: 0.64–0.92	■ Nil	46[42] 47[41]	20–30 min to complete three instruments[42]	1 time
New India QoL tool	1[35]	■ Content validity by 18 experts in medical and psychological fields ■ Pilot study on 30 patients ■ Factor analysis: – Kaiser–Meyer–Olkin: 0.83 – Bartlett's test of Sphericity: $P = 0.00$ – All factors' Eigenvalues: 8.55–1.10, accounted for 62.6% of variance	■ Cronbach's alpha overall: 0.90 ■ Guttman split-half reliability: 0.74	■ Nil	38	12–15 min	1 time
QoL Index-Cancer version	9[36,43–50]	■ Content validity by a QoL research knowledgeable person[36] ■ Pilot study with 14 patients with cancer[36] ■ Eigenvalues of eight factors: >1[36]	■ Cronbach's alpha: – Overall:[36,43,44,46–49] 0.93–098 – Subscales:[36,43,44,46,47] 0.68–0.96 – Retest:[36,49] Overall: 0.95 and subscales: 0.82–0.91 ■ Pearson's correlation between:[36,50] – Total scales and subscales: 0.61–0.76 – Subscales: 0.53–0.73 ■ Pearson's correlation test–retest:[36,49] – Entire QoL: 0.78 – Subscales: 0.65–0.83 ■ Variance testing:[45] $P = 0.002$–0.771 ■ Items stability:[45] weak correlation coefficient on items of: – Your health – Emotional support from others – Peace of mind	■ Comparing with English version:[36,49] – Similar mean score – Higher Cronbach's alpha of family subscale – Lower test–retest reliability – Lower construct validity ■ Comparing with other languages version:[49] – Similar mean score	66[44,45,48,50] 68[36,43,49] 70[46,47]	■ 10 min[43] ■ 10–15 min[36,49,50] ■ 40 min for four sets of survey instruments[48]	■ 1 time[44,46–49] ■ 2 times at intervals of 1 month[36,45] ■ 4 times at intervals of 1, 3 and 6 months[50] ■ 8 times: before chemotherapy, day 2–day 8 post chemotherapy[43]

Detailed results in Table 1 of Systematic review data extraction of the 13 included articles. QoL, quality of life.

experts. Factorial validity of the instrument reported KMO of 0.83, Bartlett's test of Sphericity was adequate with P = 0.00, Eigenvalues of all the factors ranged from 8.55 to 1.10, which accounted for 62.6% of variance.

Reliability – intra-method. The overall Cronbach's alpha of the New India QoL tool was 0.90 and split-half reliability was 0.74 (Table 2). The Guttman split-half reliability was 0.74. No information on the individual subscale reliability was provided.

QLI-CV

The Ferrans and Powers QLI was originally developed to measure the QoL of healthy persons, as well as those undergoing hemodialysis.[62–64] This instrument is slightly different from other QoL instruments. Where most instruments assess the continuum of the presence or absence of QoL well-being, the QLI-CV combines patient's perception of satisfaction with and importance of matters pertaining to QoL. It might be beneficial to ask the participants not only to quantify the satisfaction, the various functions and symptoms but also to express their view on their importance. This approach would provide a better basis for the assessment of the clinical relevance of QoL data.

There were nine studies included in this review,[36,43–50] which validated the QLI-CV instrument (Table 2). All these studies were cross-sectional[44,46–49] or longitudinal study[36,45] with convenience sample except two were RCT.[43,50] The QLI-CV instrument used by these authors was either the original version[43–47] or Arabic version[48] or Norwegian version.[36,49,50]

Validity. Among these nine articles, only Rustøen[36] conducted content and construct validity assessment.[36] The content validity assessment performed by Rustøen[36] was by a QoL research knowledgeable person, and the Eigenvalues of eight factors of the construct validity were above 1. In addition, Rustøen[36] also conducted a pilot study on 14 oncology patients.

Reliability – intra-method. Seven articles performed Cronbach's alpha to assess the reliability of QLI-CV instrument.[36,43,44,46–49] The overall Cronbach's alpha for QLI-CV instrument was 0.98–0.93; the subscales were 0.96–0.77,[36,44,46,47] except for family subscale that was reported by Wickham,[43] which was 0.68. Rustøen[36,49] also retested the Cronbach's alpha on the same sample. The test results reported by Rustøen[36,49] for the overall instrument was 0.93 and subscales were 0.79–0.88, and the retest results for the overall instrument was 0.95 and subscales were 0.82–0.91.

Besides performing Cronbach's alpha to assess the reliability of QLI-CV, Rustøen also performed test–retest correlation,[36,49] correlation of total scale with subscales,[36,50] and correlation between subscales.[36] The test–retest Pearson's correlation at 3 to 4 weeks interval was 0.65–0.83 for subscale and 0.78 for the entire instrument. The correlations between total scale and subscales of family, health and

functioning, psychological/spiritual and socioeconomic were 0.61, 0.74, 0.75 and 0.76, respectively. The correlations between subscales were 0.53 between family subscale and psychological/spiritual subscale, 0.73 between psychological/spiritual subscale and health and functioning subscale.

Amongst the two articles that did not perform Cronbach's alpha analysis, one article performed variance testing[45] and the other article performed a comparison of items stability on the QLI-CV instrument.[50] The article by Hanchett[45] only performed variance testing of the QLI-CV instrument. The findings of the variance testing were social and economic subscale ($F = 32.2$ $P = 0.002$), health and function subscale ($F = 0.657$ $P = 0.771$), family subscales ($F = 1.03$ $P = 0.479$), psychological/spiritual subscale ($F = 2.365$ $P = 0.21$) and overall scores ($F = 3.794$ $P = 0.149$).[45] The comparison of items stability was performed on the QLI-CV instrument at three interval periods of 1 month, 3 months and 9 months.[50] Items with weak correlation coefficient, which correlation coefficient result of or less than 0.30 were 'your health' in health and functioning subscale, 'emotional support from others' from socioeconomic subscale, 'peace of mind' from psychological/spiritual subscale, and all the three items in family subscale. Harrington reported removal of two items related to employment from the social/economic subscale due to a great number of missing data and inconsistent pattern of response.[44]

Reliability – inter-method. Besides intra-method validation, Rustøen[36,49] also performed inter-method validation of the Norwegian version of QLI-CV instrument with the original English version of QLI-CV[36] and different languages of QLI-CV including the English version.[49] When comparing the Norwegian version of QLI with original or Swedish version of QLI used by seven previous studies,[65–71] the author reported that there were similar mean scores on QoL across different types of disease. When comparing the Norwegian version of QLI with studies done by Ferrans,[63,64,72] Rustøen reported that the Cronbach's alpha of the family subscale was much higher than Ferrans' study,[64] and 3 to 4 weeks test–retest reliability was lower than Ferrans' study.[63] In addition, the four factors of the construct validity explained only 45% of the variance in the Norwegian sample, whereas in Ferrans' study,[72] it was reported as 91%.

Optimal frequency of assessment using identified QoL instruments

The majority of the included articles[35,40–42,44,46–49] involved a one-time cross-sectional study, which required the participants to answer the questionnaire once only (Table 2). QLI-CV was the only instrument, which required participants to answer the questionnaire more than once in four longitudinal studies.[36,43,45,50] The frequency of QoL assessment varies in these four longitudinal studies. Two studies performed assessment twice with 1-month interval.[36,45] One study had four assessments during the 9-month study period with 3–4-week interval between test 1 and test 2, 8 weeks

between test 2 and test 3, and 6 months between test 3 and 4.[50] Another study performed eight assessments at different intervals throughout the study period, before chemotherapy, and daily from day 2 to day 8 post chemotherapy.[43]

Feasibility of the use of identified QoL instruments

All of the QoL questionnaires were self-administered. Only one study was different in the early stage that data collection was conducted via telephone interview.[43] Majority of the studies did not mention the time taken to answer the QoL instruments (Table 2).

City of Hope QOL-OVCA
The QOL-OVCA instrument reported by Ferrell[40] did not mention the time taken to complete the 11-point Likert scale 45-item questionnaire.

City of Hope QOL-BC
The QOL-BC instrument by Ferrell[41] has 47 items, and the one by Ebert[42] has 46 items. Ebert[42] mentioned that the participants took 20–30 min to complete three instruments, but there was no mention of the time taken to complete the questionnaire by Ferrell.[41] The Likert scale of the instrument was an 11-point scale from 0 to 10, with 10 being the best outcomes. The scoring was reversed in 31 items of the QOL-BC instrument used by Ebert,[42] but no mention in Ferrell's research.[41]

New India QoL-Cancer Tool
The New India QoL tool was a 38-item instrument on a 4-point Likert scale with a score of 1 being very much and 4 being not at all. Out of the 38 items, 22 items were reverse scored. The time taken to complete the instrument was reported as 12–15 min, but the response rate was not reported.

QLI-CV
The QLI-CV instrument used by the nine authors consists of 33 to 35 matched items for satisfaction and importance on a 6-point Likert scale, except Hanchett,[45] who used a 5-point Likert scale on the same instrument. The scores for satisfaction and importance were combined to generate the QoL score; the higher the score, the better the QoL. Wickham[43] was the only author who collected data via interview during the first assessment, and the mode of subsequent assessment by mail was similar to other authors. The total time taken to complete the questionnaire varied from 10 min,[43] 10–15 min[36,49,50] and 40 min for four sets of survey instruments.[48]

Discussion

QoL instruments were developed as early as the 1970s for the healthy or non-cancer population.[27] However, a precise definition remains elusive as no consensus was drawn on the definition of QoL and measures used to assess it till the last decade.[17] QoL instruments for patients with cancer that were developed in the early stage were focused on patients'

functional status and emotional aspects.[17] Hence, the QoL instruments used and validated in the clinical trial studies during this period were either targeted on healthy or non-cancer population, or with QoL instruments that contained limited subscales.

As there is no 'gold standard' criterion or instrument to measure QoL,[19,49,73,74] the theoretical framework that support the development of the instrument and the context of the instrument being tested on should be considered in order to select an appropriate and relevant QoL instrument.[73] Within the health-oriented framework, QoL instruments used by clinicians should be health oriented, focused on issues that are objectives of the health care system and feasible to patients.[75] In the last decade, consensus from oncology QoL experts suggested adopting a more realistic approach on QoL instrument, which is with minimum subscales, and is health related and health sensitive, able to provide as much relevant information as possible in relation to patients' condition and cancer treatment.[17,49,75] The experts also suggested that spiritual should be included to measure QoL of patients with cancer other than physical, psychological and social functioning.[17] The experts in the QoL field agreed that it was more appropriate to make modifications where needed on existing instruments, rather than developing new instrument.[75,76] This could be the reason why no published article on development of QoL instrument for oncology patient with chemotherapy that contained all the four subscales was found within the limited years of publication set by this review, except for the New India QoL tool.

Reliability and validity of identified QoL instruments

Both the QoL instruments of QOL-BC and the New India QoL tool only underwent intra-method examination on the original version for validity and reliability assessment. Only one study was a developmental study of a new instrument, the New India QoL tool.[35]

The QOL-OVCA underwent both validity and reliability examinations by the author of the article included in this review.[40] The instrument demonstrated high internal consistency, and correlation of moderate to high between subscales and total QoL. The instrument yielded similar high Cronbach's alpha result when it underwent inter-method comparison with the generic QoL instrument by the author. However, the content validity was only on factor analysis, which may be insufficient.[29] The author suggested removing items on 'childbearing segment of the lifecycle' and 'survivorship guilt' from the instrument because of item–total correlation of less than 0.20. However, there was no reliability examination done on the instrument after removing these items.

The City of Hope QOL tool – QOL-BC underwent validity and reliability examinations in the two included article.[41,42] The instrument demonstrated a statistically significant result in reliability of internal consistency[42] and test–retest.[41,42] Content validity was considered incomplete as the authors only performed it by the panel of experts but not on cancer

patients.[29] There was no comparison of the instrument with other instruments by the authors. However, the content validity and reliability of this instrument have been already established in several studies.[61]

The New India QoL tool underwent comprehensive validity examinations in this included article during the process of instrument development.[35] However, there was no content validity of repeat pilot study on cancer patient on the final version of the instrument, which may make the validity examination incomplete. The instrument demonstrated high reliability and validity on Indian population after 6.5% of the outlier or extreme values were removed. The reliability examinations of overall Cronbach's alpha and Guttman split-half may not be sufficient for the development of a new instrument. There was no comparison of the instrument with other instruments by the author. No validation of the instrument by other region or cultural group was reported at the time of literature search.

The reliability and validity of the QLI-CV has been reasonably well documented in the clinical rather than research setting.[62] The instrument has high internal consistency, and the total index correlated highly with a measure of life satisfaction.[62]

In this review, the QLI-CV underwent intra- and inter-method reliability and comprehensive statistical analyses on the English version and translated versions by different authors, on different cultural populations. Of the nine articles included in this review, only Rustøen[36] performed content and construct validity assessment on the instrument. The instrument seems to be reliable after being translated into different languages,[36,48] though the Arabic version of the instrument by Freihat[48] only have one Cronbach's alpha value reported. The various versions of the instrument demonstrated good to excellent internal consistency, except for Wickham[43] who reported a moderate Cronbach's alpha value on family subscale. However, the mean score, test–retest reliability and the four-factor solution of the Norwegian version were not as high as the original English version used in the American sample. This could be attributed to differences in cultural values of the importance of all subscales and the way illness is experienced, which can cause validity and reliability problems. This is because instruments are likely to be biased in the setting in which they were originally developed and tested.[36] In addition, the process of translation, back-translation and review of the QoL instruments to another language may affect the cross-cultural sensitivity of the instruments.[76] Two authors, Hanchett[45] and Rustøen,[49] cited that the instrument is not specific or sensitive to differentiate between different groups, treatment or type of service when they compared their findings with other studies. One author, Rostoen,[50] found that there were unstable items of the Norwegian version instrument, and these items were less important over time during the longitudinal study.[50]

Frequency of assessment using identified QoL instruments

In this review, the majority of the authors did not mention a specific period for QoL assessment from the time of starting cancer treatment.[35,40–42,44,46–49] Only two authors detected differences in QoL trends in their longitudinal studies on QLI-CV instrument.[45,50] There were reported decreasing mean scores of some subscales between the first and second surveys, which signify an increased dissatisfaction with QoL during the 1-month study period. Majority of the QoL items with inconsistent mean scores over the study period tended to decline in the importance over time, which could be improved in adaptation to the situation.[50] There was insufficient information to support what is the optimal frequency to detect differences in patient's QoL trends during cancer treatment in this review. Patients' QoL, attitude and value may change over time during cancer treatment.[50] This knowledge can assist health-care providers to determine the appropriate care needed by their patients at a particular point of time.

Feasibility of the use of identified QoL instruments

QoL is a subjective issue, and there was consensus that it should be rated by patients themselves with the use of self-administered scale.[19] Different QoL instruments have different numbers of items although all contain the four subscales of physical, psychological, spiritual and social. There were also differences in the number of items of the same QoL instruments used by different authors in this review. For example, 46 items of City of Hope QOL-BC were used by Ebert,[42] and 47 items of City of Hope QOL-BC were used by Ferrell.[41] Another example was the QLI instrument, which 33-item instrument was used by Harrington,[44] Freihat[48] and Hanchett;[45] 34-item instrument was used by Wickham[43] and Rustøen;[36,49,50] and 35-item instrument was used by Sammarco.[46,47] The differences were often merely some additional items adapted to different patient groups, for example, split or combine items of job and unemployment for subscale of socioeconomic.[36,48]

The QoL instruments included in this review were self-administered. The time taken to complete the 46-item City of Hope QOL-BC instrument was about 20–30 min.[42] The New India QoL tool has fewer items (38 items), which took about 12–15 min to complete and is considered feasible to use in a busy setting.[35] The QLI-CV has the most number of items, which is 33–35 matched items for satisfaction and importance (total of 66–70 items), but took the shortest time (about 10–15 min) to complete.[36,43,48–50] The advantages of using short instruments include fewer burdens or time constraint on patients, higher response rate and less missing values and/or incomplete questionnaires.[77] Unfortunately, there was no information reported on the response rate for the New India QoL tool, which consists of the least items among the identified instruments in this review. One out of two articles using QOL-BC instrument reported response rate of 84.5%. For this review, the QLI-CV instrument, which participants took the shortest time to complete the most items, has the poorest response rate. There were six out of nine articles using QoL instrument of QLI-CV reported response rate of less than 32%.[36,45–47,49,50] Regarding the method of calculation, there was no mention of the QOL-OVCA, QOL-BC and the New India QoL tool.

Calculation of the QLI-CV score may not be so straightforward, as high scores are produced by combinations of high satisfaction/high importance responses.[62]

In this review, only Vidhubala[35] and Rustøen[36] reported comprehensive validity and reliability being conducted on the New India QoL tool and the QLI-CV, respectively. Unfortunately, there was no content validity examination on the final version of the New India QoL tool being reported and no comparison with any existing QoL instrument.[35] The other 11 included articles used various types of examination yet 7 reported only basic information for reliability test of Cronbach's alpha,[40,42–44,46–48] or correlation,[41,50] or variance test.[45] No validity assessment was reported for QLI-CV by 8 articles,[43–50] and QOL-OVCA.[40] Majority of the articles did not compare the findings with other QoL instruments or original version of the QoL instrument except for Ferrell and Rustøen.[36,40,49] All the included QoL instruments were feasible to patients, but there was insufficient evidence to conclude the optimal frequency of QoL assessment in this review.

Limitations of the review

The search time frame for this systematic review included the last 10 years of published research articles. There were no published articles reporting on the development of QoL instrument found within the listed databases, except for the New India QoL tool, and limited articles reporting on the validation of QoL instruments that contain all four subscales of physical, psychological, social and spiritual for the last 10 years. This was because of search limitation being set on years of the publication, which only includes the last 10 years published research articles. Hence, some articles traced from the reference list of the included articles, which were published before 1998, were excluded for this review.

This systematic review was limited to English language publications. Non-English articles may have been missed, as these articles published may not be included in the databases we searched. Hence, articles that were reported in other languages other than English were not assessed.

Conclusions

In this review, there are 4 QoL instruments being identified, which validity and reliability were reported by 13 articles. However, not all instruments have had comprehensive intra- and inter-method validation on various types of cancer by the authors of these included articles, except the QLI-CV instrument. Nevertheless, we cannot conclude that the QLI-CV is superior to other instruments. The QOL-OVCA and QOL-BC may have comprehensive validation by studies that are not included in this review.

Implications for practice

When selecting the appropriate QoL instrument to be used in the clinical setting, the clinician has to consider
1 The objective of the QoL assessment.
2 The types or gender of patients with cancer. The City of Hope QOL-BC and City of Hope QOL-OVCA are specified

for breast or ovarian cancer. Although the QLI-CV and the New India QoL tool were used for all types of cancer patient, gender was absent or underrepresented for QLI-CV, as several of the included articles included a high proportion of women with breast cancer.[36,43,45,49,50]
3 The feasibility of the instrument by using short instruments may have fewer burdens or time constraints on patients, higher response rate and less missing values and/or incomplete questionnaires.[77] In view of it, the City of Hope QOL-BC, City of Hope QOL-OVCA, and QLI-CV may be useful in the research setting but may not be feasible in the clinical setting due to the length in numbers of items. All the identified instruments seem to be easy to use by participants, who answered the questionnaires within 20 min. However, the method for calculating the score was not clear, except for QLI-CV, which was not straightforward.
4 The frequency of QoL assessment throughout the treatment period.

Implications for research

The response rates of these identified instruments were low although the time taken to complete the questionnaires were within 20 min. Research in examining shortened version of these instruments should be considered. Otherwise, the New India QoL tool, which has the least items, may be useful in the clinical setting but need further psychometric tests.

Acknowledgements

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Appendix I

Electronic databases search strategies

#	Search history	Results
APAIS Health & AustHealth on Informit AHOI (1998–2009)		
#1	qol AND cancer AND chemotherapy OR FC=(qol AND cancer AND chemotherapy)	23
Australia Centre Evidence Based clinical practice (1998–2009)		
#1	(cancer OR neoplasm) AND chemotherapy AND (QOL tool OR QOL instrument OR quality of life tool OR quality of life instrument) Health Mash-articles Limit to yr='1998–2009'	96
Biomedical Collection		
#1	(tool or instrument or measure).ab,tw.	100017
#2	(QOL or 'quality of life').ab,tw.	21117
#3	#1 AND #2	9066
#4	(cancer or neoplasm).ab,tw.	73927
#5	chemotherapy.ab,tw.	14853
#6	#3 AND #4 AND #5	638
#7	limit #6 to yr='1998–2009'	539
CINAHL		
#1	TX(tool*OR instrument* OR 'screening tool*' OR measure* OR 'assessment tool*' OR questionnaire OR scale*) OR AB(tool*OR instrument* OR 'screening tool*' OR measure* OR 'assessment tool*' OR questionnaire OR scale*)	318989
#2	TX(Qol OR 'quality of life' OR 'sickness impact profile' OR 'karnofsky performance status' OR life qualit* OR HRQoL OR 'health related quality of life') OR AB(Qol OR 'quality of life' OR 'sickness impact profile' OR 'karnofsky performance status' OR life qualit* OR HRQoL OR 'health related quality of life')	50037

Appendix I *Continued*

#	Search history	Results
#3	#1 AND #2	22642
#4	TX(adult# OR wom?n OR m?n) OR AB(adult# OR wom?n OR m?n)	587798
#5	TX(cancer# OR neoplasm# OR tumo#r# OR oncology OR malignan* OR carcinoma*) OR AB(cancer# OR neoplasm# OR tumo#r# OR oncology OR malignan* OR carcinoma*)	151568
#6	TX(drug# therap* OR therap* drug# OR cytotoxic drug# OR cytotoxic agent# OR antineoplastic agent# OR anti-neoplastic agent# OR antitumo#r agent# OR anti-tumor#r agent# OR antitumo#r drug# OR anti-tumo#r drug# OR chemotherap*) OR AB(drug#therap* OR therap* drug# OR cytotoxic drug# OR cytotoxic agent# OR antineoplastic agent# OR anti-neoplastic agent# OR antitumo#r agent# OR anti-tumor#r agent# OR antitumo#r drug# OR anti-tumo#r drug# OR chemotherap*)	188035
#7	#3 AND #4 AND #5 AND #6	1108
#8	Limiters-published date from 199801 to 200912	965
Clinical Medicine Netprints Collection		
#1	Browse articles-81 articles	0
#2	Subject Collection-Oncology-7 articles-Palliative medicine-3 articles	00
Cochrane Central Register of Controlled Trials (CENTRAL)		
#1	(tool$1 OR instrument$1 OR screening tool$1 OR measure$ OR assessment tool$1 OR questionnaire OR scale$1).tw,ab.	141868
#2	(QoL OR quality of life OR sickness impact profile OR karnofsky performance status OR life qualit$ OR HRQoL OR health related quality of life).tw,ab.	12488
#3	#1 AND #2	6871
#4	(adult$1 OR wom#n OR m#n).tw,ab.	83204
#5	(cancer$ OR neoplasm$ OR tumo?r OR oncology OR malignan$ OR carcinoma$).tw,ab.	49108
#6	(drug$ therap$ OR therap$ drug$1 OR cytotoxic drug$1 OR cytotoxic agent$1 OR anti-neoplastic agent$1 OR antineoplastic agent$1 OR antitumo?r agent$1 OR anti-tumo?r agent$1 OR anti-tumo?r drug$1 OR antitumo?r drug$1 OR chemotherap$).tw,ab.	20754
#7	#3 AND #4 AND #5 AND #6	64
#8	limit #7 to yr='1998 – Current (2009)'	57
Current contents		
#1	Topic=(quality of life tool) AND Topic=(cancer) AND Topic=(chemotherapy) Databases=ABES, SBS, CM, LS, AH Timespan=1998–2009	106
#2	Topic=(quality of life instrument) AND Topic=(cancer) AND Topic=(chemotherapy)	207
#3	Databases=ABES, SBS, CM, LS, AH Timespan=1998–2009 #2 OR #1	294
#4	Databases=ABES, SBS, CM, LS, AH Timespan=1998–2009 #2 OR #1 Refined by: Languages=(ENGLISH) Databases=ABES, SBS, CM, LS, AH Timespan=1998–2010	283
Digital Dissertations		
#1	(cancer*) AND (chemotherapy*) AND (quality of life tool*) OR (quality of life instrument*) <u>Date range after 1998–2009</u>	16
EBM Reviews ACP Journal club		
#1	(tool* OR instrument* OR screening tool* OR measure* OR assessment tool* OR questionnaire OR scale*).tw,ab.	2646
#2	(QoL OR quality of life OR sickness impact profile OR karnofsky performance status OR life qualit* OR HRQoL OR health related quality of life).tw,ab.	370
#3	#1 AND #2	302
#4	(adult$1 OR wom#n OR m#n).tw,ab.	2532
#5	(cancer$ OR neoplasm$ OR tumo?r OR oncology OR malignan$ OR carcinoma$).tw,ab.	771
#6	(drug$ therap$ OR therap$ drug$1 OR cytotoxic drug$1 OR cytotoxic agent$1 OR anti-neoplastic agent$1 OR antineoplastic agent$1 OR antitumo?r agent$1 OR anti-tumo?r agent$1 OR anti-tumo?r drug$1 OR antitumo?r drug$1 OR chemotherap$).tw,ab.	230
#7	#3 AND #4 AND #5 AND #6	7
#8	limit #7 to yr='1998 – Current (2009)'	4
EBM Reviews – Health Technology Assessment		
#1	tool* OR instrument* OR screening tool* OR measure* OR assessment tool* OR questionnaire OR scale*).tw.	1018
#2	(QoL OR quality of life OR sickness impact profile OR karnofsky performance status OR life qualit* OR HRQoL OR health related quality of life).tw.	492

Appendix I *Continued*

#	Search history	Results
#3	#1 AND #2	179
#4	(adult$1 OR wom#n OR m#n).tw.	908
#5	(cancer$ OR neoplasm$ OR tumo?r OR oncology OR malignan$ OR carcinoma$).tw.	1398
#6	(drug$ therap$ OR therap$ drug$1 OR cytotoxic drug$1 OR cytotoxic agent$1 OR anti-neoplastic agent$1 OR antineoplastic agent$1 OR antitumo?r agent$1 OR anti-tumo?r agent$1 OR anti-tumo?r drug$1 OR antitumo?r drug$1 OR chemotherap$).tw.	712
#7	#3 AND #4 AND #5 AND #6	4
#8	limit #7 to yr='1998 – Current (2009)'	4
Embase		
#1	'quality of life':ab,ti AND [embase]/lim AND [1998–2009]/py	64,184
#2	qol:ab,ti AND [embase]/lim AND [1998–2009]/py	8,814
#3	'sickness impact profile':ab,ti AND [embase]/lim AND [1998–2009]/py	407
#4	'karnofsky performance status':ab,ti AND [embase]/lim AND [1998–2009]/py	798
#5	hrqol:ab,ti AND [embase]/lim AND [1998–2009]/py	3,083
#6	'health related quality of life':ab,ti AND [embase]/lim AND [1998–2009]/py	9,874
#7	'life quality':ab,ti AND [embase]/lim AND [1998–2009]/py	1,667
#8	'life qualities':ab,ti AND [embase]/lim AND [1998–2009]/py	18
#9	OR #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8	
#10	tool:ab,ti AND [embase]/lim AND [1998–2009]/py	101,685
#11	tools:ab,ti AND [embase]/lim AND [1998–2009]/py	50,229
#12	measure:ab,ti AND [embase]/lim AND [1998–2009]/py	130,479
#13	measures:ab,ti AND [embase]/lim AND [1998–2009]/py	175,569
#14	measurement:ab,ti AND [embase]/lim AND [1998–2009]/py	114,285
#15	instrument:ab,ti AND [embase]/lim AND [1998–2009]/py	27,200
#16	instruments:ab,ti AND [embase]/lim AND [1998–2009]/py	20,662
#17	instrumental:ab,ti AND [embase]/lim AND [1998–2009]/py	10,111
#18	'screening tool':ab,ti AND [embase]/lim AND [1998–2009]/py	3,431
#19	'screening tools':ab,ti AND [embase]/lim AND [1998–2009]/py	982
#20	'assessment tool':ab,ti AND [embase]/lim AND [1998–2009]/py	1,973
#21	'assessment tools':ab,ti AND [embase]/lim AND [1998–2009]/py	1,563
#22	questionnaire:ab,ti AND [embase]/lim AND [1998–2009]/py	97,590
#23	questionnaires:ab,ti AND [embase]/lim AND [1998–2009]/py	35,016
#24	scale:ab,ti AND [embase]/lim AND [1998–2009]/py	147,477
#25	scales:ab,ti AND [embase]/lim AND [1998–2009]/py	28,308
#26	OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #10 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25	730,962
#27	adult:ab,ti AND [embase]/lim AND [1998–2009]/py	173,723
#28	adults:ab,ti AND [embase]/lim AND [1998–2009]/py	114,280
#29	woman:ab,ti AND [embase]/lim AND [1998–2009]/py	64,512
#30	women:ab,ti AND [embase]/lim AND [1998–2009]/py	250,122
#31	man:ab,ti AND [embase]/lim AND [1998–2009]/py	65,496
#32	men:ab,ti AND [embase]/lim AND [1998–2009]/py	138,797
#33	#27 OR #28 OR #29 OR #30 OR #31 OR #32	656,685
#34	cancer:ab,ti AND [embase]/lim AND [1998–2009]/py	393,262
#35	cancers:ab,ti AND [embase]/lim AND [1998–2009]/py	62,656
#36	neoplasm:ab,ti AND [embase]/lim AND [1998–2009]/py	13,164
#37	tumor:ab,ti AND [embase]/lim AND [1998–2009]/py	283,585
#38	tumour:ab,ti AND [embase]/lim AND [1998–2009]/py	59,254
#39	oncology:ab,ti AND [embase]/lim AND [1998–2009]/py	30,212
#40	malignant:ab,ti AND [embase]/lim AND [1998–2009]/py	90,719
#41	malignancy:ab,ti AND [embase]/lim AND [1998–2009]/py	34,552
#42	carcinoma:ab,ti AND [embase]/lim AND [1998–2009]/py	142,267
#43	carcinomas:ab,ti AND [embase]/lim AND [1998–2009]/py	36,751
#44	#34 OR #35 OR #36 #37 OR #38 OR #39 #40 OR #41 OR #42 OR #43	719,754
#45	'drug therapy':ab,ti AND [embase]/lim AND [1998–2009]/py	10,354
#46	'drugs therapy':ab,ti AND [embase]/lim AND [1998–2009]/py	46
#47	'drug therapies':ab,ti AND [embase]/lim AND [1998–2009]/py	1,369
#48	'drugs therapies':ab,ti AND [embase]/lim AND [1998–2009]/py	14
#49	'therapeutic drug':ab,ti AND [embase]/lim AND [1998–2009]/py	2,870
#50	'cytotoxic agent':ab,ti AND [embase]/lim AND [1998–2009]/py	702

Appendix I *Continued*

#	Search history	Results
#51	'cytotoxic agents':ab,ti AND [embase]/lim AND [1998–2009]/py	2,339
#52	'anti+tumor agent':ab,ti AND [embase]/lim AND [1998–2009]/py	194
#53	'anti+tumor agents':ab,ti AND [embase]/lim AND [1998–2009]/py	187
#54	'anti+tumour agent':ab,ti AND [embase]/lim AND [1998–2009]/py	50
#55	'anti+tumour agents':ab,ti AND [embase]/lim AND [1998–2009]/py	63
#56	'anti+tumour drug':ab,ti AND [embase]/lim AND [1998–2009]/py	29
#57	'anti+tumour drugs':ab,ti AND [embase]/lim AND [1998–2009]/py	30
#58	'anti+tumor drug':ab,ti AND [embase]/lim AND [1998–2009]/py	152
#59	'anti+tumor drugs':ab,ti AND [embase]/lim AND [1998–2009]/py	30
#60	'anti+neoplastic agent':ab,ti AND [embase]/lim AND [1998–2009]/py	55
#61	'anti+neoplastic agents':ab,ti AND [embase]/lim AND [1998–2009]/py	124
#62	chemotherapy:ab,ti AND [embase]/lim AND [1998–2009]/py	92,041
#63	chemotherapies:ab,ti AND [embase]/lim AND [1998–2009]/py	1,025
#64	'therapeutic drugs':ab,ti AND [embase]/lim AND [1998–2009]/py	1,122
#65	'cytotoxic drug':ab,ti AND [embase]/lim AND [1998–2009]/py	637
#66	'cytotoxic drugs':ab,ti AND [embase]/lim AND [1998–2009]/py	1,939
#67	#45 OR #46 OR #47 OR #48 OR #49 OR #50 OR #51 OR #52 OR #53 OR #54 OR #55 OR #56 OR #57 OR #58 OR #59 OR #60 OR #61 OR #62 OR #63 OR #64 OR #65 OR #66	111,918
#68	#9 AND #26 AND #33 AND #44 AND #67	211
Expanded Academic Index		
#1	[ab(neoplasm* OR cancer*)] AND [ab(chemotherapy)] AND [ab('quality of life' OR QOL)] AND [ab(tool* OR instrument* OR scale*)] limit results by publication date after 2007	9
MEDLINE		
#1	(tool$1 OR instrument$1 OR screening tool$1 OR measure$ OR assessment tool$1 OR questionnaire OR scale$1).ab.tw.	1356830
#2	(Qol OR quality of life OR sickness impact profile OR karnofsky performance status OR life quality$ OR HRQoL OR health related quality of life).ab.tw	80333
#3	#1 AND #2	38120
#4	(adult$1 OR wom#n OR m#n).ab.tw.	1033265
#5	(cancer$ OR neoplasm$ OR tumo?r OR oncology OR malignan$ OR carcinoma$).ab.tw.	891885
#6	(drug$ therap$ OR therap$ drug$1 OR cytotoxic drug$1 OR cytotoxic agent$1 OR antineoplastic agent$1 OR anti-neoplastic agent$1 OR antitumo?r agent$1 OR anti-tumor?r agent$1 OR antitumo?r drug$1 OR anti-tumo?r drug#$1 OR chemotherap$).ab.tw.	146844
#7	#3 AND #4 AND #5 AND #6	309
#8	limit #7 to yr='1998–2009'	291
MEDNAR		
#1	Title('quality of life' neoplasm cancer chemotherapy tools measure) Medical societies. Started date: 1998–01–01/ Enddate: 2009–12–31.	25
Ovid nursing		
#1	(tool$1 OR instrument$1 OR screening tool$1 OR measure$ OR assessment tool$1 OR questionnaire OR scale$1).ab,tw.	66213
#2	(QOL OR quality of life OR sickness impact profile OR karnofsky performance status OR life qualit$ OR HRQoL OR health related quality of life).ab,tw.	7644
#3	#1 and #2	2974
#4	(adult$1 OR wom#n OR m#n).ab,tw.	56182
#5	(cancer$ OR neoplasm$ OR tumo?r OR oncology OR malignan$ OR carcinoma$).ab,tw.	25366
#6	(drug$ therap$ OR therap$ drug$1 OR cytotoxic drug$1 OR cytotoxic agent$1 OR anti-neoplastic agent$1 OR antineoplastic agent$1 OR antitumo?r agent$1 OR anti-tumo?r agent$1 OR anti-tumo?r drug$1 OR antitumo?r drug$1 OR chemotherap$).ab,tw.	3734
#7	#3 AND #4 AND #5 AND #6	36
#8	limit #7 to yr='1998 –Current (2009)'	33
PsycARTICLES		
#1	(tool$1 OR instrument$1 OR screening tool$1 OR measure$ OR assessment tool$1 OR questionnaire OR scale$1).tw,ab.	416981
#2	(QOL OR quality of life OR sickness impact profile OR karnofsky perfORmance status OR life qualit$ OR HRQoL OR health related quality of life).tw,ab.	27791
#3	#1 AND #2	22206
#4	(adult$1 OR wom#n OR m#n).tw,ab.	312068
#5	(cancer$ OR neoplasm$ OR tumo?r OR oncology OR malignan$ OR carcinoma$).tw,ab.	158787

Appendix I *Continued*

#	Search history	Results
#6	(drug$ therap$ OR therap$ drug$1 OR cytotoxic drug$1 OR cytotoxic agent$1 OR anti-neoplastic agent$1 OR antineoplastic agent$1 OR antitumo?r agent$1 OR anti-tumo?r agent$1 OR anti-tumo?r drug$1 OR antitumo?r drug$1 OR chemotherap$).tw,ab.	39491
#7	#3 AND #4 AND #5 AND #6	2033
#8	limit 7 to (yr='1998 – Current (2009)' and psycarticles)	116
PsycEXTRA		
#1	AB(Cancer OR Neoplasm) AND AB chemotherapy AND AB('Quality of life tool' OR 'Quality of life measure') limited to year: Jan 1998–2009	0
PsycINFO		
#1	(tool$1 OR instrument$1 OR screening tool$1 OR measure$ OR assessment tool$1 OR questionnaire OR scale$1).ab.	605487
#2	(QOL OR quality of life OR sickness impact profile OR karnofsky performance status OR life qualit$ OR HRQoL OR health related quality of life).ab.	22770
#3	#1 AND #2	11993
#4	(adult$1 OR wom#n OR m#n).ab.	410844
#5	(cancer$ OR neoplasm$ OR tumo?r OR oncology OR malignan$ OR carcinoma$).ab.	28493
#6	(drug$ therap$ OR therap$ drug$1 OR cytotoxic drug$1 OR cytotoxic agent$1 OR anti-neoplastic agent$1 OR antineoplastic agent$1 OR antitumo?r agent$1 OR anti-tumo?r agent$1 OR anti-tumo?r drug$1 OR antitumo?r drug$1 OR chemotherap$).ab.	5070
#7	#3 AND #4 AND #5 AND #6	63
#8	limit 7 to yr='1998 –Current (2009)'	55
Social Science Citation Index		
#1	Topic= (cancer chemotherapy) AND Topic= (quality of life) AND Topic= (qol)refined Topic= (tool*) limit 7 to yr='1998 –Current (2009)'	31
Sociological Abstracts		
#1	AB Quality of life tool OR Quality of life measure OR QOL tool AND Chemotherapy AND (Cancer OR Neoplasm) Limited year: 1998–2009, journal article, English	0

Appendix II

Quality assessment tool (adapted from Elliot 2007[28])

		Critical appraisal tool for Reliability and Validity studies				
	Items	Description		Yes	No	Not clear
		Inter method studies (A:validation of QoL tool with another tool / B:same tool of different language)	Intra method studies (C:development of QoL tools)			
1	Was an appropriate method used to test the reliability of the QoL instrument?	Is correlation being tested between the 2 instruments?	Mention of these in the three Domains: **Stability**: Test–retest reliability, parallel of alternate form. **Homogeneity**: item–total correlation, split-half, KR-20, Cronbach's's alpha **Eqiivalance**: inter-rater, parallel or alternate form.			
2	Is the reliability (r values) of the QoL instrument adequate?	Is the reliability (r values) of the instrument adequate?	Mention of these in the three Domains: **Stability**: Test–retest reliability, parallel of alternate form. **Homogeneity**: item–total correlation, split-half, KR-20, Cronbach's alpha (≥0.7 will signify good reliability) **Eqiivalance**: inter-rater, parallel or alternate form.			

Appendix II *Continued*

		Critical appraisal tool for Reliability and Validity studies				
	Items	Description		Yes	No	Not clear
		Inter method studies (A:validation of QoL tool with another tool / B:same tool of different language	Intra method studies (C:development of QoL tools)			
3	Was an appropriate method(s) used to test the validity of the QoL instrument?	Is instrument assessed independently?	Whether there are: 1. Factor analysis/expert opinion 2. Construct validity 3. Regression analysis 4. Contrasted groups 5. Hypothesis testing 6. Convergent divergent			
4	Is the validity of the QoL instrument adequate?	Was gold standard being used in study well validated?	What are the result of: 1. Factor analysis/expert opinion 2. Construct validity 3. Regression analysis 4. Contrasted groups 5. Hypothesis testing 6. Convergent divergent			
5	Are strengths and weaknesses of the reliability and validity appropriately addressed in the 'Discussion', 'Limitations', or 'Recommendations' sections of the report?					

Appendix III

Systematic review Data Extraction Form (modified from systematic review articles published in JBI Library[37-39])

Author (yr)	Type & version of QoL instruments used	Study Design	Population	Sample size	Validity	Reliability		Feasibility	Frequency of assessment	Author's Conclusion	Reviewer's Conclusion
						Intra-method	Inter-method				

Appendix IV

Excluded studies

Retrieved articles excluded after critical appraisal by two reviewers

Reason for exclusion: QoL instruments used did not contain four subscales for all of these following articles

Balboni TA, Vanderwerker LC, Block SD *et al*. Religiousness and spiritual support among advanced cancer patients and associations with end-of-life treatment preferences and quality of life. *J Clin Oncol* 2007; **25:** 555–60.

Bloom JR, Stewart SL, Chang S, Banks PJ. Then and now: quality of life of young breast cancer survivors. *Psychooncology* 2004; **13:** 147–60.

Calhoun EA, Welshman EE, Chang CH *et al*. Psychometric evaluation of the Functional Assessment of Cancer Therapy/Gynecologic Oncology Group – Neurotoxicity (Fact/GOG-Ntx) questionnaire for patients receiving systemic chemotherapy. *Int J Gynecol Cancer* 2003; **13:** 741–8.

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Campbell A, Mutrie N, White F, McGuire F, Kearney N. A pilot study of a supervised group exercise programme as a rehabilitation treatment for women with breast cancer receiving adjuvant treatment. *Eur J Oncol Nurs* 2005; **9:** 56–63.

Cella D, Peterman A, Hudgens S, Webster K, Socinski MA. Measuring the side effects of taxane therapy in oncology – The functional assessment of cancer therapy-taxane (FACT-taxane). *Cancer* 2003; **98:** 822–31.

Cella D, Zagari MJ, Vandoros C, Gagnon DD, Hurtz HJ, Nortier JWR. Epoetin alfa treatment results in clinically significant improvements in quality of life in anemic cancer patients when referenced to the general population. *J Clin Oncol* 2003; **21:** 366–73.

Chan YM, Ng TY, Ngan H, Wong LC. Quality of life in women treated with neoadjuvant chemotherapy for advanced ovarian cancer: a prospective longitudinal study. *Gynecol Oncol* 2003; **88**: 9–16.

Cheung YB, Wong LC, Tay MH *et al*. Order effects in the assessment of quality of life in cancer patients. *Qual Life Res* 2004; **13**: 1217–23.

Costanzo ES, Lutgendorf SK, Rothrock NE, Anderson B. Coping and quality of life among women extensively treated for gynecologic cancer. *Psychooncology* 2006; **15**: 132–42.

Costet N, Lapierre V, Benhamou E, Galès CL. Reliability and validity of the Functional Assessment of Cancer Therapy General (FACT-G) in French cancer patients. *Qual Life Res* 2005; **14**: 1427–32.

Cull A, Howat S, Greimel E *et al*. Development of a European Organization for Research and Treatment of Cancer questionnaire module to assess the quality of life of ovarian cancer patients in clinical trials: a progress report. *Eur J Cancer* 2001; **37**: 47–53.

Cullen MH, Billingham LJ, Woodroffe CM *et al*. Mitomycin, ifosfamide, and cisplatin in unresectable non–small-cell lung cancer: Effects on survival and quality of life. *J Clin Oncol* 1999; **17**: 3188–94.

De Moor JS, De Moor CA, Basen-Engquist K, Kudelka A, Bevers MW, Cohen L. Optimism, distress, health-related quality of life, and change in cancer antigen 125 among patients with ovarian cancer undergoing chemotherapy. *Psychosom Med* 2006; **68**: 555–62.

Eller LS, Lev EL, Gejerman G *et al*. Prospective study of quality of life of patients receiving treatment for prostate. *Cancer Nurs Res* 2006; **55** (2 Suppl.): S28–36.

Fisch MJ, Titzer ML, Kristeller JL *et al*. Assessment of quality of life in outpatients with advanced cancer: the accuracy of clinician estimations and the relevance of spiritual well-being-a Hoosier Oncology Group Study. *J Clin Oncol* 2003; **21**: 2754–9.

Gershenson DM, Miller AM, Champion VL *et al*. Reproductive and sexual function after platinum-based chemotherapy in long-term ovarian germ cell tumor survivors: a Gynecologic Oncology Group Study. *J Clin Oncol* 2007; **25**: 2792–7.

Golden-Kreutz DM, Thornton LM, Wells-Di Gregorio S *et al*. Traumatic stress, perceived global stress, and life events: prospectively predicting quality of life in breast cancer patients. *Health Psychol* 2005; **24**: 288–96.

Haas BK. *Fatigue, self-efficacy for physical activity, physical activity, and quality of life in women with breast cancer* [PhD]. The University of Texas at Austin, Texas, USA, 2001.

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Hilarius DL, Kloeg PH, Gundy CM, Aaronson NK. Use of health-related quality-of-life assessments in daily clinical oncology nursing practice. *Cancer* 2008; 1**13**: 628–37.

Holzner B, Kemmler G, Greil R *et al*. The impact of hemoglobin levels on fatigue and quality of life in cancer patients. *Ann Oncol* 2002; **13**: 965–73.

Jacobsen PB, Meade CD, Stein KD, Chirikos TN, Small BJ, Ruckdeschel JC. Efficacy and costs of two forms of stress management training for cancer patients undergoing chemotherapy. *J Clin Oncol* 2002; **20**: 2851–62.

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Joly F, Espie M, Marty M, Heron JF, Henry-Amar M. Long-term quality of life in premenopausal women with node-negative localized breast cancer treated with or without adjuvant chemotherapy. *Br J Cancer* 2000; **83**: 577–82.

Klemp JR. *Evaluating the effects of chemotherapy on cognitive function and quality of life in pre-menopausal women with breast cancer* [PhD]. University of Kansas, Kansas, USA, 2007.

Kudel IC. *Investigation of a Two-Factor Model of Quality of Life*. US: ProQuest Information & Learning, 2004.

Mintz CD. *The development of a cancer-specific quality of life scale* [MA]. The University of Manitoba (Canada), Canada, 1998.

Mock V, Pickett M, Ropka ME *et al*. Fatigue and quality of life outcomes of exercise during cancer treatment. *Cancer Pract* 2001; **9**: 119–27.

Ozyilkan O, Baltali E, Tekuzman G, Firat D. The impact of diagnosis and treatment on the quality of life in breast cancer patients. *Neoplasma* 1998; **45**: 50–2.

Pelletier G, Verhoef MJ, Khatri N, Hagen N. Quality of life in brain tumor patients: the relative contributions of depression, fatigue, emotional distress, and existential issues. *J Neurooncol* 2002; **57**: 41–9.

Peuckmann V, Ekholm O, Rasmussen NK *et al*. Chronic pain and other sequelae in long-term breast cancer survivors: nationwide survey in Denmark. *Eur J Pain* 2009; **13**: 478–85.

Rademacher J. *Impact of spiritual well-being on quality of life in women undergoing chemotherapy for early stage breast cancer* [PhD]. University of Cincinnati, Ohio, USA, 2006.

Raghavendra RM, Nagarathna R, Nagendra HR *et al*. Effects of an integrated yoga programme on chemotherapy-induced nausea and emesis in breast cancer patients. *Eur J Cancer Care* 2007; **16**: 462–74.

Rausch SM. *Evaluating the psychosocial effects of two interventions, Tai Chi and spiritual growth groups, in women with breast cancer* [PhD]. Virginia Commonwealth University, Virginia, USA, 2007.

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Ganz PA, Guadagnoli E, Landrum MB, Lash TL, Rakowski W, Silliman RA. Breast cancer in older women: quality of life and psychosocial adjustment in the 15 months after diagnosis. *J Clin Oncol* 2003; **21:** 4027–33.

Ganz PA, Kwan L, Stanton AL *et al*. Quality of life at the end of primary treatment of breast cancer: first results from the moving beyond cancer randomized trial. *J Natl Cancer Inst* 2004; **96:** 376–87.

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Swenson MM, MacLeod JS, Williams SD, Miller AM, Champion VL. Quality of living among ovarian germ cell cancer survivors: a narrative analysis. *Oncol Nurs Forum* 2003; **30**: E56–62.

Wenzel L, Fairclough D, Brady M *et al*. Age related differences in the quality of life of breast carcinoma patients after treatment. *Cancer* 1999; **86**: 1768–74.

Zebrack BJ. Cancer survivor identity and quality of life. *Cancer Pract* 2000; **8**: 238–42.

Reason for exclusion: No reported validity/reliability assessment of QoL instrument for all of these following articles

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Chou F, Dodd M, Abrams D, Padilla G. Symptoms, self-care, and quality of life of Chinese American patients with cancer. *Oncol Nurs Forum* 2007; **34**: 1162–7.

De Backer IC, Van Breda E, Vreugdenhil A, Nijziel MR, Kester AD, Schep G. High-intensity strength training improves quality of life in cancer survivors. *Acta Oncol* 2007; **46**: 1143–1151.

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