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A preliminary prospective study of health-related quality of life among Chinese-American breast cancer survivors

Kimlin Tam Ashing[1] · Sophia Yeung[2] · Lily Lai[2] · Lucy Young[3] · Alison G. Wong[4]

Abstract

Purpose This study examined the predictors of health-related quality of life (HRQOL) and changes in HRQOL over a 1-year period among Chinese-American breast cancer survivors (BCS).

Methods A two-wave longitudinal research design included participants from hospital-based cancer registries and community organizations in Los Angeles. Participants completed mailed questionnaires at baseline and 12-month follow-up. HRQOL was measured using the Functional Assessment of Cancer Therapy-General (FACT-G v.4). Change in HRQOL was assessed using a 7-point meaningful change score.

Results Participants were 73 Chinese-American BCS, a majority of whom were middle-aged ($M = 54.6$, $SD = 9.2$), lower income (63% < 45K), and diagnosed with stage I–II (83%) breast cancer. Regression analyses showed that multilevel contextual factors including general health perception, quality of care, life stress, and improvement in general health perception significantly predicted HRQOL at baseline and follow-up. The final model explained 72% of the variance of HRQOL. The examination of meaningful change indicated that improvement was reported by 32% ($n = 22$) and deterioration by 25% ($n = 17$); the majority indicated minimal change (43%, $n = 30$). Improvement was associated with increases in family communication, social support, and general health perception, while deterioration was associated with declines in social support, family communication, and general health perception.

Conclusion Findings indicate that among Chinese-American BCS, HRQOL is influenced by socioecological factors such as family communication and life stress. Results suggest that cancer survivorship outcomes research may benefit from theoretical foundations that examine the broader contextual dimensions that seem to impact and predict HRQOL. Implications for research are discussed.

Keywords Oncology · Cancer · Chinese-American · Breast carcinoma · Health-related quality of life · Prospective study

Background

Breast cancer (BCA) is the most common cancer in Chinese-American women [1–3]. The number of breast cancer survivors (BCS) in the Asian-American population in the USA continues to rise with early detection, and advances in medical treatments have led to a 91.7% 5-year survival rate among Chinese-Americans specifically [4]. The growing proportion of Chinese-American BCS in the USA generates interest in understanding differences in health-related quality of life (HRQOL) outcomes. HRQOL data are relevant to assessing survivorship outcomes including treatment side effects and distress [5–10]. However, notable gaps in the literature exist.

HRQOL is a multifarious construct measuring physical, social, emotional, and functional well-being [6, 11]. These HRQOL dimensions are documented to have cross-cultural

✉ Kimlin Tam Ashing
kashing@coh.org

1. Department of Population Sciences, City of Hope Comprehensive Cancer Center, Beckman Research Institute, 1500 E Duarte Road, Duarte, CA 91010-3000, USA

2. Lung Cancer Screening and Prevention Program, City of Hope National Medical Center, Duarte, CA, USA

3. Herald Cancer Association, Chinese Christian Herald Crusades, San Gabriel, CA, USA

4. Fuller Theological Seminary, School of Psychology & Marriage and Family Therapy, Pasadena, CA, USA

relevance [12, 13]. However, examining HRQOL among ethnic and linguistic groups in the USA remains understudied [14–16]. Thus, survivorship research suffers from the lack of ethnic minority representation that the increasingly diverse survivor population warrants.

HRQOL of Chinese and Chinese-American BCS

Data on the HRQOL of Chinese-Americans is scarce, and prospective longitudinal studies are few. In the USA, studies with Chinese-American BCS reported that a BCA diagnosis may have greater deleterious effects among immigrants compared to those born in the USA [17]. The less than favorable outcomes can be attributed to several factors including language barriers and low acculturation [18, 19], self-stigma [20], inadequate medical communication [21], and culturally dissonant medical care approaches [19]. Studies with Asian-American BCS supported that the women's role and familial factors, such as self-sacrifice and fear of burdening others, strongly influence survivorship including treatment decision-making and HRQOL outcomes [6, 19, 20]. In addition, Chinese-American BCS often experience difficulties communicating their experience with others. One longitudinal study found that perceived social support mediated the relationship between ambivalence over emotional expression and quality of life over time [22]. Chinese-American BCS may exhibit restraint in disclosing illnesses and expressing their needs and choose to rely solely on the support of close relatives [19]. Communication challenges are exacerbated by the lack of social support outside the family.

Furthermore, Chinese-American BCS may express symptoms in culturally unique ways (e.g., hot–cold imbalances) [18, 19]. Studies also revealed that Chinese immigrant BCS may be at risk for greater distress compared with US-born Chinese and European-American BCS because of cultural norms that make them less inclined to express their emotions and needs to physicians or challenge physicians when their needs are not met [21]. These findings suggest that Chinese-American BCS may have significant unmet needs.

Purpose

The aim is to examine multilevel predictors of HRQOL including the contributions of understudied factors, e.g., socioecologic factors. To capture multilevel factors on HRQOL, the current study adapted the *contextual model of HRQOL* to guide the approach, measures, and data analyses [12]. In this modified context framework, health outcomes are thought to be shaped by two levels of determinants: (1) structural determinants of health inequities consisted of the sociopolitical context (e.g., ethnicity, gender, age) and socioeconomic context (e.g., income, education); and (2) intermediary social determinants of

health include the psychosocial context (e.g., social and family support), behavioral context (e.g., behavioral risk practices), socioecological context (e.g., life stress, neighborhood aspects), general health context (e.g., general health perceptions), and health system context (e.g., quality of care). Thus, this study examined broad contributions including socioecologic factors in predicting HRQOL of Chinese-American BCS at baseline and then change in HRQOL over a 1-year timeframe.

Methods

Design and subjects

This study employed a prospective design to examine HRQOL status at baseline and 1 year later. Participants were (1) Chinese-Americans; (2) within 6 months to 3 years of BCA diagnosis; (3) diagnosed with stages 0–III BCA; (4) void of other major disabling medical or psychiatric condition; and (5) 18 years of age or older. BCS were identified via the City of Hope Medical Center and community partners (i.e., TzuChi Foundation, Herald Cancer Association). The institutional review board approval was obtained and all participants signed a consent form to participate.

Procedure

Recruitment letters were mailed to potential participants instructing them to contact the research office if they were interested. Brief telephone screenings were conducted with interested individuals to assess eligibility. Eligible BCS who agreed to participate were asked to indicate their language preference for study participation (English or simplified Chinese) and were mailed 2 copies of the consent form, the baseline survey, and a return envelope. At 6 months post-baseline, each participant received a reminder letter regarding the 12-month follow-up survey. The expected survey completion time was 1 h for the baseline and 30 min for the follow-up. Each participant received a $40 gift certificate upon completing each of the surveys. Contact materials (i.e., questionnaire, consent form) were translated into Chinese using forward and backward translation procedures by two bilingual translators. Over 90% of the participants completed the surveys in Chinese.

Measures

Outcome measure: health-related quality of life

The Functional Assessment of Cancer Therapy (FACT-G v.4) assessed the overall HRQOL [23–25]. It is comprised of 27 items that are rated from 0 (not at all) to 4 (very much), with

higher scores indicating better HRQOL. The FACT-G has four subscales, assessing physical (PWB), social/family (SWB), emotional (EWB), and functional well-being (FWB). Scores were added for a total global FACT-G score; and raw scores were reported. Reliability and validity of the FACT-G in this sample are presented elsewhere [26].

Predictors

The selection of predictors were informed by the *contextual model of HRQOL* [12]. In this modified *context framework*, health outcomes are thought to be shaped by two levels of determinants: (1) *structural determinants of health inequities* consisted of the sociopolitical context (e.g., ethnicity, gender, age) and socioeconomic context (e.g., income, education); (2) *intermediary social determinants of health* includes the psychosocial context (e.g., social and family support), behavioral context (e.g., behavioral risk practices), socioecological context (e.g., life stress), general health context (e.g. general health perceptions), and health system context (e.g., quality of care). We used variables from our survey that assessed 6 of these contexts to explore their contributions to HRQOL outcomes.

Sociopolitical and economic context Demographic information (i.e., age) and socioeconomic status (i.e., income, education) were assessed.

Psychosocial context *Social support* was assessed through the MOS social support survey, which is a 19-item measure consisting of 4 subscales: emotional/informational; tangible; affectionate; and positive social interaction. The measure also contains on general item that assesses perceived availability of social support [27]. Items are rated on a 5-point Likert scale ranging from 1 (lowest) to 5 (highest), with higher scores indicating better social support. The social support score was computed by averaging all items. The internal consistency of the MOS in this sample was high ($\alpha = 0.971$).

Family communication was assessed with a family communication measure that was adapted from the family assessment device (FAD) and family hardiness index (FHI) [28, 29]. The measure consists of 7 items measuring the individual's perception on family coping in response to life issues. Each item is rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Family communication score was the sum of the item scores, with higher scores indicating better family communication. The internal consistency for the sample was $\alpha = 0.898$.

General health context The SF-36 instrument assessed the perception of the overall health status and general health beliefs [30, 31]. The general health subscale consists of 5 subscale item scores, ranging from 0 to 100 with a higher score indicating better well-being. This SF-36 subscale measures overall health perceptions, while the FACT-G PWB subscale assesses comorbidity and symptom-oriented components. The internal consistency of the SF-36 for this sample was $\alpha = 0.856$.

Health system context *Quality of care* was measured with an adapted version of the interpersonal aspects of care scale from the Adherence Determinants Questionnaire to measure how BCS perceive the quality of patient–physician relationship [32]. The scale has 13 items, and each item is scored on a scale from 1 (lowest) to 5 (highest). The internal consistency for this sample was high ($\alpha = 0.913$). The quality of care was assessed at baseline only because items pertained to the time of treatment.

Socioecological context *Life stress* was assessed with the life stress scale, 19 items measuring the level of stress associated with socioecological domains (e.g., finances, neighborhood) [33, 34]. Each item is scored on a scale from 1 (no stress) to 5 (extreme stress). The internal consistency of the life stress scale was $\alpha = 0.901$. Life stress was assessed at baseline only.

Data analyses

Descriptive analyses, including means, standard deviations, ranges, and percentages, were calculated to examine the characteristics of the variables. We examined mean changes in predictive and outcome variables at baseline and follow-up and then used paired *t*-tests to evaluate the significance of changes. Next, correlation analyses (Pearson's *r* and Spearman' rho) were conducted to examine the bivariate associations between baseline predictors and HRQOL at baseline and follow-up.

Linear regression analyses examined the associations between HRQOL outcomes and the predictive variables of the modified context framework. The linear regression models were constructed by entering the predictors along with the order of the theoretical framework: from structural factors (e.g., income, education) to intermediary factors (e.g., socioecological and systemic dimensions). The *R*-square was used to determine the best fitting model reflecting the HRQOL outcomes.

Then, another set of regression analyses were conducted to examine the relationships between socioecological factors and HRQOL status while controlling for change and longitudinal effects of independent variables. The same set of baseline predictors were entered to determine their predictability of prospective HRQOL results 1 year later. The final model is adjusted for change scores in social support, family communication, and general health perception as these dimensions are vulnerable to change over a 1-year period.

In consideration of power and sample size, cancer stage was excluded because BCS participants were screened for stage 0–3A, only. In the regression models, the mean substitution was used to replace a small number of missing observations (< 10%) in the selected variables.

In addition, we assessed the change in HRQOL in a temporal pattern to examine survivorship outcomes over time. We categorized the baseline HRQOL in three levels: lower third (scores < 68), middle third (scores between 68 and 86), and upper third (scores > 86). Utilizing the three levels, we examined changes in BCS's HRQOL at baseline and 12-month follow-up. Change scores in global FACT-G were generated by subtracting baseline scores from follow-up scores. Change scores were evaluated using a conservative 7-point meaningful change scale found in emerging data on clinical significance of the FACT-G [35–39]. Changes from baseline to follow-up HRQOL indicated deterioration (≤ -7 points), minimal change (-6.9 to $+6.9$ points), or improvement ($\geq +7$ points). Factors associated with changes in HRQOL were examined. All analyses were conducted using the SPSS 15.0 statistical package [40].

Results

Demographic and medical characteristics

Results were based on data from 73 participants who completed baseline and follow-up surveys 1 year later. Participants were all Chinese immigrants, mostly from Hong Kong, China, and Taiwan. Only 3 participants completed the surveys in English; the rest were completed in Chinese. Sample attrition reduced the numbers of BCS from a total of 111 enrolled at baseline, yielding a retention rate of 66%. Participants' demographic characteristics, presented in Table 1, indicated that most were married (75%), middle-aged ($M = 54.6$, $SD = 9.2$, range = 31–83), completed high school (92%), preferred Chinese language (83%), and were lower income < 45K (63%). BCS in the work force was reduced from 42 to 34% over the 1-year study period. At baseline, 50% reported professional/technical occupations, while homemaker was the most endorsed (30%) occupation at follow-up. Over half (56%) of the participants reported having health insurance provided by HMO, PPO, and Medicare.

The average age at diagnosis was 53.0 ($SD = 8.7$) years, and the mean year since diagnosis was 2.4 ($SD = 2.0$). The majority of BCS (81%) reported stage I–II BCA at diagnosis. Chemotherapy was the most endorsed cancer treatment (73%). The number of comorbidities increased significantly from 1.9 ($SD = 2.1$) at baseline to 2.3 ($SD = 2.0$) at follow-up ($p = 0.033$). Data from

one participant who reported BCA metastasis during the study period was removed to ensure the data reflected stage 0–3 survivors.

Table 1 Demographic and medical characteristics ($n = 73$)

Variables	Baseline (n, %)
Age (yrs) (mean, SD)	54.6 (9.2)
Years in the USA (mean, SD)	19.9 (10.3)
Relationship status	
Unpartnered	18 (25.4)
Partnered	53 (74.6)
Education	
< High school	6 (8.3)
High school	9 (12.5)
> High school	57 (79.2)
Language preference	
English	11 (15.7)
Chinese	58 (82.9)
Currently working	30 (41.7)
Occupation	
Homemaker	19 (26.4)
Professional	23 (31.9)
Tech/admin	13 (18.1)
Service/labor	8 (11.1)
Other	9 (12.5)
Income	
< 25 K	28 (38.9)
25–45 K	17 (23.6)
45–75 K	14 (19.4)
> 75 K	13 (18.1)
Insurance	
HMO/PPO/Medicare	40 (55.6)
Medi-Cal	15 (20.8)
No insurance	17 (23.6)
	Mean (SD)
Age at diagnosis (yrs)	53.0 (8.8)
Years since diagnosis	2.4 (1.9)
Mean no. comorbidity	1.9 (2.1)
Cancer stage	n (%)
0	6 (8.3)
I	24 (33.3)
II	34 (47.2)
III	8 (11.1)
Surgery	
Lumpectomy	33 (45.2)
Axillary node	34 (46.6)
Mastectomy	42 (57.5)
Chemotherapy	50 (72.5)
Radiation	36 (52.9)
Hormone therapy	49 (69.0)

We compared the baseline characteristics between the retained subjects to those who were lost to follow-up ($n = 37$). The non-retained subjects were more likely to have lower (< 25K) or higher (> 75K) incomes ($p = 0.006$); older age ($p = 0.041$); and longer time since BCA diagnosis ($p = 0.046$).

Change in HRQOL predictors

Table 2 presents the means, standard deviations, and results of paired sample t-tests of the measures. Family communication declined significantly from 28.4 ($SD = 5.0$) to 25.6 ($SD = 6.9$) ($p = 0.005$) from baseline to follow-up. Declines were also observed in general health perception (baseline, $M = 56.0$, $SD = 23.7$; follow-up, $M = 54.1$, $SD = 22.5$) and social support (baseline, $M = 63.3$, $SD = 17.7$; follow-up, $M = 59.7$, $SD = 17.3$); however, these changes were not significant ($p > 0.05$). Global FACT-G scores improved slightly from baseline ($M = 70.6$, $SD = 21.2$) to follow-up ($M = 72.9$, $SD = 18.1$) ($p = 0.206$).

Correlation matrix of outcomes and predictors

Correlation matrices explored the bivariate associations between predictive factors and overall HRQOL at baseline and follow-up. Social support ($r = 0.56$–0.65), family communication ($r = 0.32$–0.57), general health perception ($r = 0.53$–0.70), quality of care ($r = 0.43$–0.52), and life stress ($r = -0.46$–-0.47) indicated significant correlations with overall HRQOL at baseline and at follow-up ($p < 0.01$).

Predictors of HRQOL at baseline

Linear regression analyses were conducted to predict HRQOL outcomes (Table 3). Baseline HRQOL outcomes (i.e., global FACT-G/subscales) were regressed with baseline demographic and socioecological factors to examine their overall statistical relationships.

The results of the linear regression analyses of predictors of baseline HRQOL are presented in Table 3. Our predictive model provided the most robust estimate of the HRQOL outcome and accounted for 72% of the explainable variance (R-square = 0.721; $F = 27.646$; $p < 0.001$). Family communication ($p = 0.005$), general health perception ($p < 0.001$), quality of care ($p < 0.001$), and life stress ($p = 0.001$) significantly predicted HRQOL. For the subscale outcomes, our predictive model best explained variability in the social well-being (SWB) and family well-being (FWB) domains (R-square = 0.587 and 0.728, respectively). General health perception ($p < 0.009$) and life stress ($p < 0.020$) significantly predicted better outcomes in the physical well-being (PWB), emotional well-being (EWB) and FWB domains.

Predictors of HRQOL at follow-up

We were interested in whether these baseline contextual variables and their observed changes would predict HRQOL status 1 year later (Table 4). Social support status at baseline significantly predicted prospective HRQOL ($p = 0.023$) in model 5, but the significance disappeared in model 6 when life stress was included ($p = 0.010$). Model 6 showed that BCS who indicated better general health perception ($p = 0.002$), better quality of care ($p = 0.003$), and less life stress ($p = 0.010$) reported significantly better HRQOL 1 year later. Considering the effect of change, model 7 adjusted for change scores in social support, family communication, and general health perception; improvement in general health perception significantly predicted prospective HRQOL ($p = 0.017$) over and above its baseline scores. The change score modeling approach was important in predicting prospective HRQOL, given the increase of variance explained (5%) (R-square =

Table 2 Psychometric scale information ($n = 73$)

Variables	Score range	Reliability, α	Baseline (mean, SD)	Follow-up (mean, SD)	Difference	p-value
FACT-G	11–107	0.957	70.6 (21.2)	72.9 (18.1)	2.332	0.206
Physical well-being	0–28	0.922	19.0 (6.6)	19.5 (6.0)	0.485	0.556
Social/family well-being	0–28	0.881	19.4 (6.7)	18.2 (6.5)	−1.265	0.075
Emotional well-being	0–24	0.860	17.1 (5.5)	17.3 (5.1)	0.189	0.695
Functional well-being	0–28	0.946	17.5 (7.3)	17.8 (6.3)	0.277	0.608
Social support	27–95	0.971	63.3 (17.7)	59.7 (17.3)	−3.509	0.103
Family communication	10–35	0.898	28.4 (5.0)	25.6 (6.9)	−2.788	0.005
General health perception	0–100	0.856	56.0 (23.7)	54.1 (22.5)	−1.875	0.377
Quality of care	26–65	0.913	51.8 (7.4)	N/A	N/A	N/A
Life stress	20–81	0.901	34.9 (12.2)	N/A	N/A	N/A

Paired t-test were used for the mean comparisons. Higher scores indicate better outcomes, except life stress

Table 3 Linear regression model: baseline variables predicting baseline HRQOL outcomes (FACT-G/subscales) (n=73)

Variables (baseline)	FACT-G		PWB		SWB		Baseline HRQOL EWB		FWB	
	B ± S.E.	p-value	B ± S.E.	p-value	B ± S.E.	p-value	B ± S.E.	p-value	B ± S.E.	p-value
Step 1. Sociopolitical context	*(R-squ: 0.017)*		*(R-squ: 0.013)*		*(R-squ: 0.000)*		*(R-squ: 0.007)*		*(R-squ: 0.004)*	
Age (continuous)	−0.019 ± 0.167	0.910	0.039 ± 0.076	0.615	−0.067 ± 0.069	0.332	−0.049 ± 0.066	0.463	−0.092 ± 0.061	0.138
Step 2. Socioeconomic context	*(R-squ: 0.109)*		*(R-squ: 0.162)*		*(R-squ: 0.027)*		*(R-squ: 0.047)*		*(R-squ: 0.065)*	
Income (< 45K vs.≥ 45 K)	2.670 ± 1.639	0.108	1.983 ± 0.748	0.010	−0.040 ± 0.676	0.953	0.617 ± 0.647	0.344	0.109 ± 0.598	0.856
Education (≤ HS vs. > HS)	3.227 ± 3.492	0.359	0.213 ± 1.593	0.894	0.856 ± 1.441	0.555	−0.128 ± 1.379	0.926	1.846 ± 1.274	0.152
Step 3. Psychosocial context	*(R-squ: 0.451)*		*(R-squ: 0.291)*		*(R-squ: 0.451)*		*(R-squ: 0.192)*		*(R-squ: 0.357)*	
Social support	−0.013 ± 0.111	0.906	−0.054 ± 0.050	0.286	0.031 ± 0.046	0.504	0.018 ± 0.044	0.682	−0.018 ± 0.040	0.650
Family communication	0.941 ± 0.320	0.005	0.246 ± 0.146	0.097	0.499 ± 0.132	< 0.001	−0.078 ± 0.126	0.537	0.255 ± 0.117	0.032
Step 4. Biological context	*(R-squ: 0.621)*		*(R-squ: 0.387)*		*(R-squ: 0.522)*		*(R-squ: 0.260)*		*(R-squ: 0.636)*	
General health perception	0.422 ± 0.065	< 0.001	0.098 ± 0.030	0.002	0.088 ± 0.027	0.002	0.069 ± 0.026	0.009	0.190 ± 0.024	< 0.001
Step 5. Health system context	*(R-squ: 0.703)*		*(R-squ: 0.414)*		*(R-squ: 0.578)*		*(R-squ: 0.375)*		*(R-squ: 0.704)*	
Quality of care	0.987 ± 0.213	< 0.001	0.177 ± 0.097	0.073	0.259 ± 0.088	0.005	0.308 ± 0.084	0.001	0.314 ± 0.078	< 0.001
Step 6. Environmental context	*(R-squ: 0.721)*		*(R-squ: 0.477)*		*(R-squ: 0.587)*		*(R-squ: 0.443)*		*(R-squ: 0.728)*	
Life stress	−0.446 ± 0.126	0.001	−0.160 ± 0.057	0.007	−0.061 ± 0.052	0.246	−0.139 ± 0.050	0.007	−0.109 ± 0.046	0.020

Missing data in regression models were replaced with mean substitution. *PWB*, physical well-being; *SWB*, social/family well-being; *EWB*, emotional well-being; *FWB*, functional well-being

0.508 improved to 0.553, $p = 0.065$) when change scores were introduced in the model.

Who experienced change?

We pursued further analyses to identify BCS who experienced change in HRQOL. Results presented in Table 5 indicate that 32% BCS experienced improvement ($n = 22$), 43% minimal change ($n = 30$), and 25% deterioration ($n = 17$). Among the 22 BCS who experienced improvement, 64% ($n = 14$) were in the lower third HRQOL (FACT-G score) category (range 0–62) at baseline. Among the 17 BCS who experienced deterioration, 53% ($n = 9$) were in the upper third category (range 82–108) at baseline. BCS in the middle third HRQOL category (range 63–81) were evenly distributed in the three change groups.

Table 5 also presents the 7-point meaningful change scores of social support, family communication, and general health perception as they relate to the upper, middle, and lower third categories of HRQOL scores at baseline. Among the BCS who experienced HRQOL improvement, positive mean change scores were observed in social support (+4.9 points), family communication (+2.5 points), and general health perception (+2.9 points). Among the BCS who experienced deterioration in HRQOL from all categories including the high third HRQOL, the middle third HRQOL and lower third HRQOL showed large changes in general health perception (−14.4, −24.2 and −30.0 points, respectively). Further, BCS who reported HRQOL deterioration demonstrated notable declines in social support ($M = −12.4$ points).

Discussion

This study investigated the influence of multilevel factors on HRQOL over time among Chinese-American BCS. Overall, HRQOL improved from baseline to 12 months, but this change was not statistically significant.

Factors predicting HRQOL in Chinese-American BCS

Results of the regression analyses showed that social support, family communication, general health perception, quality of care, and life stress significantly predicted HRQOL at baseline. Our predictive model accounted for a total of 72% of the explained variance in overall HRQOL. Psychosocial factors alone (i.e., social support/family communication) accounted for 35% of the explained variance, while general health perception accounted for 15% of the explained variance in HRQOL at baseline. Furthermore, baseline general health perception, quality of care, and life stress also served as significant predictors of HRQOL at follow-up. Also, changes in general

Table 4 Step-wise regression model: dependent variable-FACT-G follow-up (*n*=74)

Variables (baseline)	Model 1 B ± S.E.	Model 2 B ± S.E.	Model 3 B ± S.E.	Model 4 B ± S.E.	Model 5 B ± S.E.	Model 6 B ± S.E.	Model 7 B ± S.E.
Step 1. Sociopolitical context							
Age (continuous)	0.123 ± 0.237	0.285 ± 0.249	0.296 ± 0.219	0.123 ± 0.214	−0.001 ± 0.208	−0.156 ± 0.207	−0.165 ± 0.189
Step 2. Socioeconomic context							
Income (< 45K vs. ≥ 45 K)		4.271 ± 2.535	1.830 ± 2.296	0.865 ± 2.194	1.936 ± 2.113	1.328 ± 2.035	
Education (≤ HS vs. > HS)		2.011 ± 5.698	1.033 ± 5.017	1.064 ± 4.741	0.842 ± 4.497	2.235 ± 4.336	
Step 3. Psychosocial context							
Social support			0.534 ± 0.139[b]	0.383 ± 0.141[b]	0.316 ± 0.136[a]	0.197 ± 0.137	0.211 ± 0.139
Family communication			0.322 ± 0.439	0.179 ± 0.418	−0.170 ± 0.414	−0.116 ± 0.397	0.024 ± 0.410
Step 4. Biological context							
General health perception				0.267 ± 0.089[b]	0.268 ± 0.084[b]	0.259 ± 0.081[b]	0.373 ± 0.086[b]
Step 5. Health system context							
Quality of care					0.800 ± 0.276[b]	0.805 ± 0.265[b]	0.592 ± 0.259[a]
Step 6. Environmental context							
Life stress						−0.412 ± 0.156[a]	−0.343 ± 0.152[a]
Step 7. Change score							
ΔSocial support							0.060 ± 0.140
ΔFamily Communication							0.016 ± 0.252
ΔGeneral health perception							0.293 ± 0.119[a]
(R-square)	*0.040*	*0.059*	*0.299*	*0.383*	*0.454*	*0.508*	*0.553*

Missing data in final models were replaced with mean substitution. [a] $P < 0.05$; [b] $P < 0.01$

health perception over time significantly predicted HRQOL at follow-up, indicating the importance of health factors in Chinese-American BCS' HRQOL.

These findings demonstrated a comprehensive and robust modeling approach to examine influential factors of HRQOL among Chinese-American BCS.

Table 5 Upper, middle, and lower baseline FACT-G total by clinically meaningful change score

Baseline FACT-G	ΔFACT-G Score		
	Deterioration (≤ −7 points) (*n* = 17)	Min. change (−6.9–6.9 points) (*n* = 30)	Improvement (≥ 7 points) (*n* = 22)
Lower 3rd (*n* = 23)			
Change score	*(n = 2)*	*(n = 7)*	*(n = 14)*
ΔSocial support	−4.0 (1)	+1.3 (14.1)	+4.9 (17.6)
ΔFamily communication	−3.0 (4.2)	−3.6 (8.0)	+2.5 (8.5)
ΔGeneral health perception	−30.0 (10)	+2.5 (9.4)	+2.9 (13.6)
Middle 3rd (*n* = 24)			
Change score	*(n = 6)*	*(n = 9)*	*(n=8)*
ΔSocial support	−3.4 (11.7)	−0.7 (8.3)	−4.8 (12.7)
ΔFamily communication	−4.0 (4.8)	−2.9 (7.0)	−5.4 (5.2)
ΔGeneral health perception	−24.0 (15.6)	+6.3 (10.6)	+4.4 (11.5)
Upper 3rd (*n* = 23)			
Change score	*(n = 9)*	*(n = 14)*	*(n = 0)*
ΔSocial support	−12.4 (9.7)	−5.5 (20.2)	N/A
ΔFamily communication	−3.6 (7.3)	−5.4 (9.3)	N/A
ΔGeneral health perception	−14.4 (11.8)	−5.8 (14.0)	N/A

BCS who experienced change over time

Additionally, we looked into the meaningful improvements and deteriorations in the FACT-G scores (Table 5) of greater than or less than 7 points proposed by the HRQOL literature [35–39]. Our results showed that of the BCS in the lower third HRQOL (FACT-G) at baseline, 61% demonstrated meaningful improvements. These improvements were accompanied by increases in family communication, social support, and general health perception. Conversely, of the BCS in the upper third HRQOL at baseline, 39% demonstrated meaningful deteriorations. Deteriorations were accompanied by declines in social support, family communication, and general health perception. Deteriorations in general health perceptions suggest that maintaining BCS' physical health and reducing comorbidity-related symptoms may help them achieve a more favorable survivorship [41].

Deteriorations in HRQOL and psychosocial factors such as social support and family communication highlight the importance of family as the basic structural and functional unit among Chinese-Americans [20]. For example, married BCS (75%) in this sample considered their family members as central to their survivorship experience, especially at the time of diagnosis and during the first year of survivorship. Family members may experience "equal suffering" when caring for patients; therefore, cancer-coping interventions that focus on the whole family may have additional positive effects to BCS' recovery [42]. Following the first 1–2 years post-diagnosis and treatment, there remains considerable social support needs that family members might not have the resources to fulfill. It may be during this long-term survivorship phase that continued formal and informal supportive services from outside sources may become important to Chinese-American BCS. Specifically, interventions to enhance social support could be an important factor to improve psychological adjustment and lower distress [8, 43]. The rigorous evaluations presented in this study confirm that changes in psychosocial and health factors are good indicators to determining HRQOL in Chinese-American BCS.

Although quality of care and socioecological aspects, e.g., life stress and neighborhood, were not assessed in our 1-year follow-up, their significance in predicting HRQOL warrants further attention. In Los Angeles, cancer patients may have access to Chinese physicians for regular medical and oncological care. These physicians could provide care that is consistent with cultural norms and language preferences, thus enhancing language consistency and satisfaction with care [20]. In addition, the role of life stress in health-related outcomes was documented in other ethnic minorities [44] but understudied with Chinese-American BCS. BCS are more susceptible to life stress due to their facing a life-threatening disease. As well, our study suggests that BCS who experience greater life stress including neighborhood concerns may have

compromised HRQOL. Thus, further examination of the role of socioecological challenges is warranted.

Our cohort's HRQOL score (FACT-G, 70.7–73.3) was lower compared to the normative data of a population-based European-American adult cancer patient sample (80.9) and a Hong Kong BCS sample (77.7–82.2) [10, 35]. This observation may be due to lower income status and the possible effects of acculturative stress including differences in environment, family structure, cultural and language barriers, and social network due to living in the USA. This finding necessitates further attentions from healthcare providers and research to understand the HRQOL among Chinese-American BCS.

There are several limitations to the current study. First, we used a convenience sample recruited from hospital registries and community agencies. Respondents may not be a representative sample of all Chinese-American BCS. Additionally, we did not include BCS who were unreachable and did not complete the 1-year post. This could potentially bias the sample to including BCS who were healthier and more favorable HRQOL outcomes. Finally, the factors explored in each context were not comprehensive. Within the sociopolitical and economic context, for example, factors such as financial distress, which has been shown to be associated with lower quality of life, were not included [45]. Although the design may limit the generalizability of the results, this research represents one of the few studies to prospectively investigate survivorship outcomes among Chinese-American BCS. These results can be used to inform future research on the effect of BCA on HRQOL in general; and in particular outcomes research with Chinese-American and other Asian-American groups.

In summary, results indicated that contextual factors and their change over time predicted HRQOL at baseline and follow-up, suggesting potential daily living strains on HRQOL among Chinese-American BCS. Our findings suggest that among Chinese-American BCS, HRQOL is significantly influenced by family communication and life stress. This study contributes to the limited data on Chinese-Americans diagnosed with breast cancer. Additionally, the inclusion of Chinese-Americans in cancer outcomes research is needed in order to better understand the HRQOL and survivorship experience among our diverse populations. Further, studies grounded in theoretical and methodological frameworks that are culturally responsive may provide practical guides to enhance diversity inclusion, as well as investigate factors relevant to HRQOL outcomes that may not have been previously considered. Our findings imply that cancer survivorship outcomes research may benefit from theoretical foundations that examine the broader contextual dimensions that seem to impact and predict HRQOL. More research is needed to better understand and address the socioecologic and other risk factors for deterioration in HRQOL to reduce the undue disease burden. As well, studies must seek to identify HRQOL

boosters to inform interventions to improve survivorship outcomes.

Availability of data and material Request for data addressed to Dr Ashing will be considered.

Declarations

Ethics approval Approval was obtained from the City of Hope Institutional Review Board. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Informed consent Informed consent was obtained from all individual participants included in the study.

Consent for publication The manuscript was submitted for consideration of publication in the Supportive Care in Cancer. The manuscript is not under consideration or previously published elsewhere.

Conflicts of interest The authors declare no competing interests.

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