A Causal Model of Health-Related Quality of Life Among Thai Adolescent Survivors of Childhood Cancer: A Cross-Sectional Study

Busayarat Silapavitayatorn, Jutarat Mesukko, Srimana Niyomkar, Petsunee Thungjaroenkul*

Abstract: Improving health-related quality of life among adolescents who have survived childhood cancer is now a significant concern for healthcare professionals. To design effective interventions that elevate this health-related quality of life, understanding the relevant factors and how they work to influence their health-related quality of life is essential. This cross-sectional study aimed to develop and test a causal model of health-related quality of life among Thai adolescents who are survivors of childhood cancer. Data were collected at four tertiary hospitals in Thailand from 473 Thai adolescents who survived childhood cancer, utilizing nine instruments, including a Demographic Data Form, the Children Fatigue Scale, the Sleep Disturbance Scale for Children, the Children's Depression Inventory, the Functional Status Questionnaire, the State Self-Esteem Scale, the Thai Family Functioning Scale, the Friend APGAR Questionnaire, and the Pediatric Quality of Life Inventory 4.0. Initial data analysis employed descriptive statistics, followed by structural equation modeling performed using the Mplus program.

The final model fitted with the research data and accounted for 70.8% of the variation in health-related quality of life. Fatigue, sleep disturbance, depression, and functional status influenced health-related quality of life through both direct and indirect pathways. Family functioning and peer support were found to only indirectly influence health-related quality of life via self-esteem. Self-esteem was found to directly influence health-related quality of life, and its influence was the strongest. Therefore, nurses can design the interventions that emphasize promoting self-esteem, educating and encouraging adolescent survivors of childhood cancer to use effective symptom management strategies to reduce fatigue, sleep disturbances, and depression to improve functional status, along with fostering good family functioning and providing peer support groups, that can enhance self-esteem, leading to a higher health-related quality of life in this population.

Keywords: Adolescent survivors, Childhood cancer, Family functioning, Functional status, Health-related quality of life, Peer support, Self-esteem

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Introduction

Adolescent survivors of childhood cancer (ASoCC) refer to adolescents 13-18 years[1] who have survived from cancers that occur in children aged 0-14 years both hematologic cancer and solid

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tumor.[2] In the United States, around 9,550 children were diagnosed with cancer per year.[3] Approximately 1,000-1,200 children in Thailand are diagnosed with cancer every year.[4] As cancer treatment becomes more effective, 85% of children with cancer currently survive for 5 years or more,[3] and in turn, the population of ASoCC has increased. In 2022, there were approximately 49,120 American ASoCC.[5] In Thailand, children with cancer had an increased survival rate of 47.20%.[6] These children will grow up to be a large number of Thai ASoCC. Therefore, nurses and healthcare professionals encounter ASoCC unavoidably.

A literature review revealed that the phases of cancer survivorship consist of three phases, including the acute survivorship phase, which begins with cancer diagnosis and continues with treatment; the extended survivorship phase, which begins when the patient completes the course of treatment or goes into remission; and the permanent survivorship phase, which is often called "cancer-free."[7] However, ASoCC in the extended survivorship phase are often neglected because everyone may believe that cancer was cured already.[8] In fact, ASoCC in this phase are still affected by common physical and psychological late effects of cancer and its treatment, including fatigue, sleep disturbance,[9] and depression.[10] These late effects greatly affect the ability of ASoCC to live, resulting in poor health-related quality of life (HRQoL).[9,10]

A previous study indicated that ASoCC had a lower HRQoL than chronically ill children and adolescents, and healthy children and adolescents.[11] Therefore, enhancing HRQoL is essential for ASoCC. This requires an understanding of the factors that affect their HRQoL. Understanding the various factors and how they affect HRQoL is important for designing effective interventions to enhance HRQoL in this population.

Conceptual Framework and Review of Literature

This study utilized two primary sources to direct its research framework: the revised Wilson and Cleary Model (WCM) for HRQoL,[12] and findings from the literature concerning variables associated with HRQoL in ASoCC. In the revised WCM,[12] the five main components are biological function, symptom, functional status; general health perceptions, and overall QoL. Overall QoL constitutes the person's subjective perception regarding the consequences of the disease and its treatment on their lives.[12] Biological function has a direct influence on symptoms, and symptoms have an indirect influence on overall QoL through functional status and general health perception. These five main components are also directly influenced by individual and environmental characteristics. Acknowledging the interchangeable application of the terms "overall QOL," "QOL," and "HRQOL" within the revised WCM, this research will consistently employ "HRQOL" to ensure maximum clarity. Although a literature review found that types of tumours (biological function) and gender (characteristics of the individual) were associated with HRQoL among ASoCC,[13] these factors were not modifiable and were therefore excluded from this study. Seven modifiable factors (fatigue, sleep disturbance, depression, functional status, self-esteem, family functioning, and peer support) were selected to construct the causal model and are described as follows:

Fatigue, sleep disturbance, and depression are reported as common physical and psychological late effects of cancer and its treatment in ASoCC.[9,10] They were conceptualized to represent a construct of the symptoms. Children and ASoCC who experience fatigue have physical exhaustion and altered mood. Fatigue had a negative impact on many aspects of their lives, including activities of daily living, emotional reactions to situations, social interactions, and school performance,[14] and it is associated with low functional status[15] and HRQoL.[14] In addition, adolescents and young adults who survived childhood cancer with sleep disturbance often experience excessive daytime sleepiness that makes it hard for them to stay awake during the day, which affects their ability to perform daily functions.[16] Sleep disturbance has been found to be a significant predictor of poor functional status[15] and HRQoL.[16] Moreover, children and ASoCC with depression feel very sad, leading to a loss of interest in daily functioning.[17] Depression is positively related to functional disability in children and ASoCC,[17] and negatively related to HRQoL in teenage and adult long-term survivors of childhood cancer.[18]

Functional status refers to the ability of a person to perform tasks.[19] Because of the combined impact of diverse cancer therapies and the resulting harm to different organs, children and ASoCC tend to have more activity limitations and functional status impairment.[20] Previous study revealed that physical activity is positively related to self-esteem in breast cancer survivors,[21] and functional status positively influences HRQoL in children and adolescents with cancer.[22]

Self-esteem refers to a person's overall evaluation of thoughts and feelings regarding self-worth,[23] which is closely linked to perceptions of health.[24] Self-esteem is a crucial developmental task during adolescence.[25] However, in ASoCC, cancer and its treatment can lead to changes in appearance, physical mobility, and social interactions, which can negatively impact their self-esteem.[25] Self-esteem involves an individual's overall evaluation of themselves, encompassing both physical and psychological aspects.[24] Individuals with high self-esteem tend to have a more optimistic and resilient perspective, which can help them feel better and cope more effectively with health challenges, thereby improving HRQoL. Prior studies have shown a positive correlation between self-esteem and HRQoL in children and ASoCC.[26,27]

Family functioning and peer support are viewed as characteristics of the environment. Family functioning refers to the accomplishment of its responsibilities.[28] This is a crucial element within the familial setting that directly affects the psychological well-being and HRQoL among teenagers and young adult cancer survivors.[29] Among ASoCC, family cohesion positively influences self-esteem.[30] In addition, family functioning is positively related to HRQoL in children and adolescents with cancer.[31] Peer support refers to how an individual perceives the help offered by friends in different areas.[32] During adolescence, the peer group is the primary socializing context, and ASoCC consider their peers as a major source of emotional support.[33] In children and ASoCC, peer support positively influences self-esteem,[33] and satisfaction with peer relationships positively influences HRQoL.[26]

In summary, the existing literature has identified seven factors associated with HRQoL among ASoCC. Notably, most previous studies were conducted with mixed-age cancer survivors, which can blur the association between these factors and HRQoL among ASoCC. In addition, those studies were conducted in other countries with cultures, contexts, and family systems different from Thai society. Moreover, no studies have been found reporting a full model of causal relationships among ASoCC in the Thai context. To address this knowledge gap, we developed a causal model of HRQoL for Thai ASoCC. This model was constructed by adapting the revised WCM[12] and conducting a thorough review of existing literature on HRQoL in this population. The causal relationships among seven predictive factors on HRQoL are presented in **Figure 1**. It was hypothesized that the proposed model would align with the empirical data.

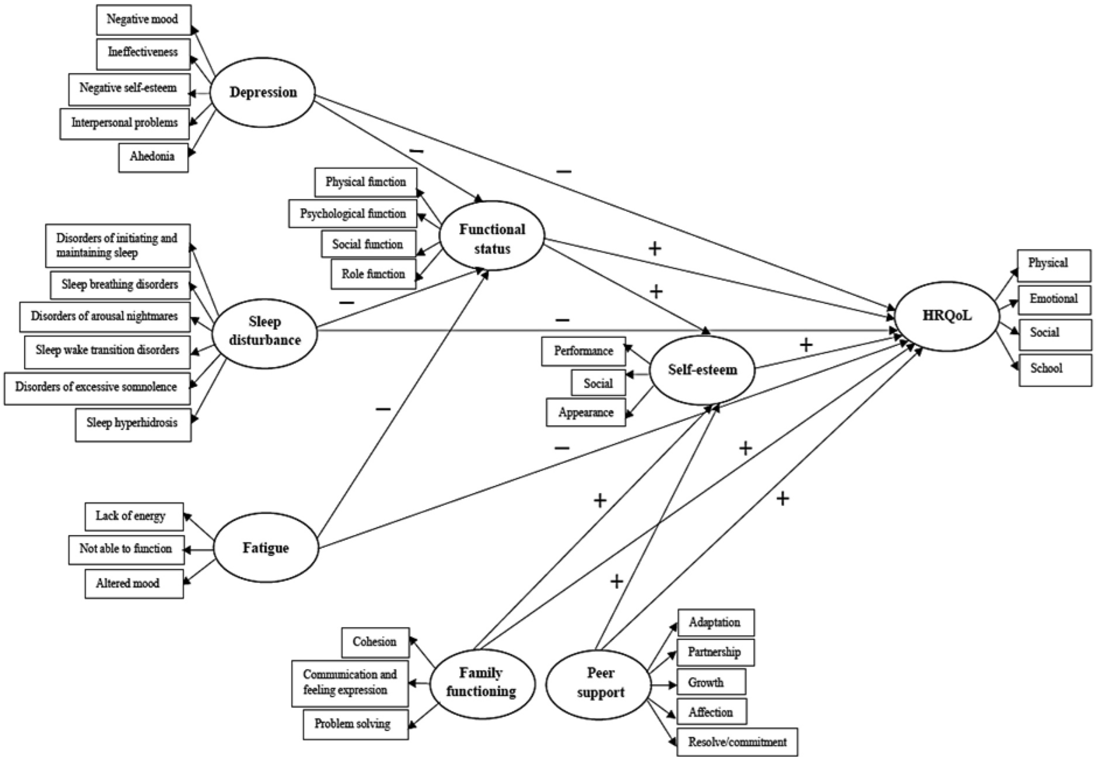


Figure 1. The hypothesized model of HRQoL among Thai ASoCC

Study Aim

The study aimed to construct and evaluate a model to investigate the direct and indirect impacts of fatigue, sleep disturbance, depression, functional status, self-esteem, family functioning, and peer support on HRQoL among Thai ASoCC.

Methods

Design: This investigation employed a descriptive, cross-sectional, and correlational study design. Furthermore, this paper's reporting adheres strictly to the STROBE guidelines, specifically those developed for cross-sectional studies.

Sample and Setting: A sample size for structural equation modeling (SEM) was determined by using a subject-to-parameter ratio (N:q) of 10:1.[34] The hypothesized model in this study contained 46 parameters. Thus, there were 460 subjects (10 x 46). A 10% sampling allowance (46 participants) was determined for attrition and missing data.[35] Hence, this study required a sample size of 506 participants. A multi-stage sampling technique was employed. Initially, three of the six regions in Thailand were chosen using a simple random sampling method. Next, four tertiary hospitals from eight within the three chosen regions were selected, also by simple random sampling. One tertiary hospital was selected from the North, another from the Northeast, and two from the South. Finally, we selected participants from each chosen hospital using proportional purposive sampling from databases in 2021 (**Figure 2**). The inclusion criteria were: Thai ASoCC aged 13-18 years, diagnosed with leukemia, lymphoma, and CNS tumors, who completed cancer treatment between 3 months and 10 years prior, who had no physician-diagnosed cancer recurrence, and who were proficient in speaking, reading, and writing Thai.

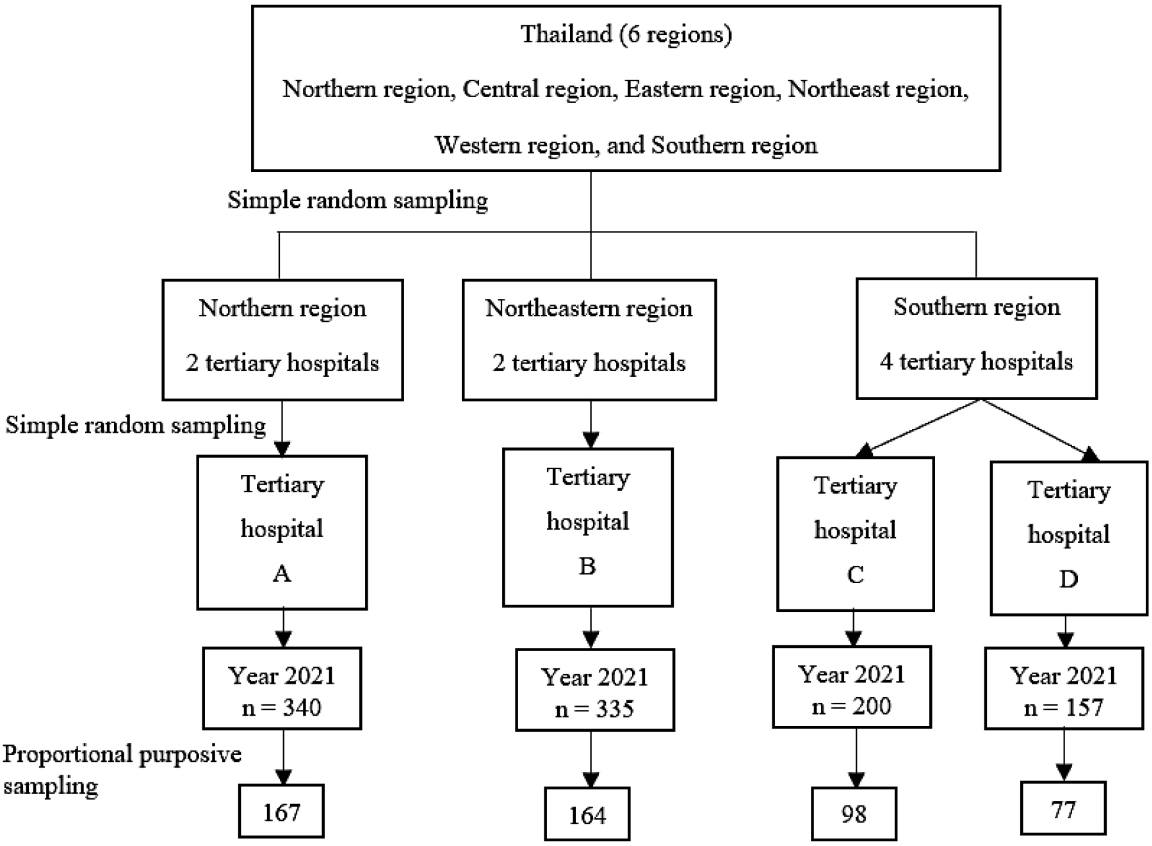


Figure 2. Multi-stage sampling technique of this study

Ethical Considerations: Prior to implementation, the protocol for this research received approval from the Research Ethics Committee of the Faculty of Nursing, Chiang Mai University (Research ID 024/2566, Study Code 2565-FULL024), as well as the institutional review boards of four hospitals. All eligible participants and their parents received comprehensive information regarding the study's procedures, their voluntary participation, the assurance of privacy and non-disclosure, and their absolute freedom to decline or discontinue involvement at any time without penalty.

Instruments: Nine instruments were used, four of which were translated with permission into Thai: the Children Fatigue Scale, Sleep Disturbance Scale for Children, Functional Status Questionnaire, and State Self-Esteem Scale. The back-translation process of these instruments was based on Brislin's translation model.[36] The four adapted questionnaires underwent content validity by six professionals specializing in pediatric oncology and child psychiatry. Instrument reliability, excluding the demographic data tool, was subsequently evaluated in a preliminary study involving ten individuals who matched the eligibility criteria of the main sample. Reliability was further confirmed via the main research group of 473 individuals (out of 506 total, reflecting 33 pieces of missing data). The content validity index (CVI), along with the reliability findings from both the preliminary and main investigations, as well as illustrative items, are displayed in **Table 1.**

Table 1. Content validity index (CVI), reliability, specified as Cronbach's alpha, and sample items for the research instruments

Instruments	Content validity index		Cronbach's alpha		Example of item
	I-CVI	S-CVI/ Ave	Pilot study	Main Study	
CFS	1.00	1.00	0.96	0.93	I have been tired.
SDSC	0.83-1.00	0.98	0.92	0.88	You have difficulty getting to sleep at night.
CDI	N/A	N/A	0.89	0.88	I am sad once in a while.
FSQ	1.00	1.00	0.85	0.87	During the past month have you had difficulty about walking several blocks?
SSES	0.83-1.00	0.99	0.86	0.87	I feel good about myself.
TFFS	N/A	N/A	0.90	0.91	Our family members love each other.
Friend APGAR Questionnaire	N/A	N/A	0.88	0.85	I am satisfied with the way my friends and I share time together.
PedsQL Version 4.0	N/A	N/A	0.94	0.93	It is hard for me to run.

Note. CFS = Children Fatigue Scale, SDSC = Sleep Disturbance Scale for Children,
CDI = Children's Depression Inventory, FSQ = Functional Status Questionnaire, SSES = State Self-Esteem Scale, TFFS = Thai Family Functioning Scale, Friend APGAR Questionnaire: the letters APGAR denote Adaptability, Partnership, Growth, Affection, and Resolve; PedsQL Version 4.0 = Pediatric Quality of Life Inventory, Version 4.0, N/A = not applicable because this instrument was not calculated

The demographic data form collected data on age, gender, education level, major caregiver, family characteristics, type of cancer, type of treatment, and time since completion of treatment.

The Pediatric Quality of Life Inventory 4.0 (PedsQL 4.0), originally developed by Varni et al.[37] and later translated into Thai by Sritipsukho et al.,[38] was utilized to evaluate the HRQoL among children afflicted with cancer. It includes 23 items, which are classified into four principal domains: physical functioning, emotional functioning, social functioning, and school functioning. Responses are collected using a 5-point Likert scale ranging between 0 (never a problem) and 4 (almost always a problem). For data analysis, all item scores were inverted and then converted from a 0-4 range to 100-0 points. The final score ranges from 0 to 100, with higher scores indicating a superior level of HRQoL.

The Children Fatigue Scale (CFS), originally developed by Hockenberry et al.,[39] is utilized to assess fatigue in pediatric patients with cancer, specifically from the child's own viewpoint. This instrument includes 14 items across three distinct dimensions: lack of energy, not being able to function, and altered mood. Response format involves a 5-point Likert scale, ranging from 1 (not at all) to 5 (a lot). The possible total score ranges from 14 and 70, with higher value indicating a more pronounced level of fatigue.

The Sleep Disturbance Scale for Children (SDSC), initially created by Bruni et al.,[40] assesses the sleep quality and disturbance levels in both children and adolescents. The SDSC comprises 26 items that fall into six distinct dimensions: disorders of initiating and maintaining sleep; sleep breathing disorders; disorders of arousal and nightmares; sleep-wake transition disorders; disorders of excessive somnolence; and sleep hyperhidrosis. Responses are recorded on a 5-point Likert scale with values ranging from 1 (never) up to 5 (always). The possible total score extends from 26 to 130; consequently, a greater numerical value reflects a more severe sleep disturbance.

The Children's Depression Inventory (CDI), initially created by Kovac,[41] underwent a Thai adaptation by Trangkasombat and Likanapichitkul.[42] This instrument was employed for assessing the severity of manifestations of depression in pediatric and adolescent populations. The CDI consists of 27 items, which are categorized into five principal dimensions: negative mood; ineffectiveness; negative self-esteem; interpersonal problems; and anhedonia. Each item consisted of three descriptive statements, allowing individuals to select the one statement that best describes them. The measure utilizes a 3-point scale from 0 (no symptoms) to 2 (symptoms all the time). The final score ranges from 0 to 54, with higher scores indicating greater severity of depressive symptoms.

The Functional Status Questionnaire (FSQ), an instrument developed by Jette et al.,[19] is administered to identify functional decline and track clinically important shifts in patient function. This tool comprises 28 core items distributed across four dimensions: physical function (covering basic activities of daily living: BADL and intermediate activities of daily living: IADL); psychological function (mental health: MH); social function (social activities: SA and quality of interactions: QI); and role function (work performance: WP). Note that for this study, WP was adapted to school performance (SP). The BADL, IADL, and SA subscales utilize a 5-point Likert scale, spanning from 4 (usually did with no difficulty) down to 0 (usually did not do for other reasons). The MH and QI subscales employed a 6-point scale ranging from 1 (all of the time) to 6 (none of the time). The SP subscale uses a 4-point Likert scale ranging from 1 (all of the time) to 4 (none of the time). Seven items are reverse-scored. The final score ranges from 0-100; a higher score indicates superior functional status.

The State Self-Esteem Scale (SSES), created by Heatherton and Polivy,[23] is an instrument designed to measure self-esteem across multiple dimensions. The SSES comprises 20 items, categorized into three specific dimensions: performance, social, and appearance self-esteem. The response format uses a 5-point Likert scale from 1 (not at all) to 5 (extremely). Items requiring reverse scoring total thirteen. The total score spans from 20 to 100, where a greater value signifies a more elevated level of self-esteem.

The Thai Family Functioning Scale (TFFS), developed specifically in Thai by Suttiamnuaykul,[43] is designed to measure family functioning among Thai families. The TFFS contains 30 items, organized into three key dimensions: cohesion, communication and feeling expression, and problem solving. Responses are captured using a 4-point Likert scale ranging from 0 (never) to 3 (always). Eight items require reverse scoring. The final score ranges from 0 to 90; an elevated score indicates a higher level of family function.

The Friend APGAR Questionnaire, originally developed by Smilkstein et al.,[32] was translated into Thai by Malathum[44] to evaluate peer support. This instrument comprises 5 items, each corresponding to one of five dimensions: adaptation, partnership, growth, affection, and resolve/commitment. Responses are captured via a 5-point Likert scale ranging from 0 (never) to 4 (always). The total possible score ranges from 0 to 20, with higher scores indicating a superior level of peer support.

Data Collection: Data were collected from March 2023 to February 2024. The collection was carried out by the primary investigator (PI). Following approval of the study protocol by the Research Ethical Committee of the Faculty of Nursing, Chiang Mai University, and the institutional review boards at four hospitals, the PI sent letters requesting permission to collect data and access medical records from the directors of the four hospitals. After receiving permission, data collection began. The PI screened eligible participants who met the inclusion criteria from medical records facilitated by the research coordinators, who were the heads of pediatric outpatient departments (POPD) at each selected hospital. Participants who met the inclusion criteria, were willing to participate in the study, and had their parents' consent for their child's inclusion were recruited into the study. Participants and their parents were informed about the research details and ethical considerations. After agreeing to participate, participants under 18 and their parents signed the assent and consent forms, respectively, while participants aged 18 signed the consent form themselves. Then, the PI recorded the demographic data from the medical records into the demographic data form. The participants answered eight questionnaires in a private room at the POPD, divided into three sessions with a 10-minute break. Responding to the questionnaires took 60-90 minutes, and the participants were free to stop at any time if they felt fatigued. After the participants completed the questionnaires, they were thanked and given a stationery set as a token of appreciation for their involvement in the research.

Data Analysis: The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 26.0 and Mplus software version 7.2. Descriptive statistics were employed to summarize participants' characteristics. To examine the bivariate associations between all variables in the study, the Pearson's product-moment correlation coefficient was computed. Before proceeding with the SEM, fundamental assumptions were rigorously assessed. In this study, 33 missing data occurred and therefore were deleted from the data analysis, leaving 473 participants for further analysis. However, no outliers were found. Normality, linearity, and homoscedasticity were confirmed, and multicollinearity was not an issue, demonstrated by bivariate correlations of independent variables falling within the range of -0.386 to 0.588 (not exceeding 0.90).[35] Furthermore, the variance inflation factor (VIF) values were found to range between 1.062 and 1.583 (all below 2).[35] The hypothesized model was tested using the maximum likelihood estimation method to evaluate the overall model fit. This assessment was guided by the following goodness-of-fit indicators: the chi-square (χ^2) statistic should be non-significant ($p > 0.05$); the relative chi-square (χ^2/df) must be ≤ 3; the root mean square error of approximation (RMSEA) should be ≤ 0.08; the standardized root mean square residual (SRMR) must be < 0.10; and two indices, the comparative fit index (CFI) and Tucker-Lewis index (TLI), must be ≥ 0.90.[34]

Results

Characteristics of participants

Five hundred and six ASoCC willingly participated in the research and submitted all required questionnaires. Thirty-three cases were subsequently classified as "missing data" and omitted from the analyses, leaving a final sample of 473 participants for data analysis. More than half were male (62.58%), aged 13-18 years (M = 15.06, SD = 1.80). Almost two-thirds of them were in middle school (62.37%), and had their mother as the major caregiver (65.12%). More than two-thirds of them lived in an extended family (69.77%). Almost two-thirds of them were diagnosed with leukemia (65.33%). More than two-thirds of them had received chemotherapy (69.98%). The mean time since treatment completion was 4.99 years (SD = 2.63), ranging from 3 months to 10 years.

Correlation coefficients of the study variables

Regarding the relationships between predicting factors and HRQoL. Self-esteem had a high positive relationship with HRQoL. Functional status, family functioning, and peer support had moderate positive relationships with HRQoL. Sleep disturbance, depression, and fatigue had moderate negative relationships with HRQoL (**Table 2**).

Table 2. The correlation matrix showing interrelationships among research variables (n = 473)

Variables	1	2	3	4	5	6	7	8
1. Fatigue	1.000							
2. Sleep disturbance	0.514**	1.000						
3. Depression	0.487**	0.588**	1.000					
4. Function status	-0.481**	-0.386**	-0.412**	1.000				
5. Self-esteem	-0.539**	-0.445**	-0.417**	-0.572**	1.000			
6. Family functioning	-0.473**	-0.434**	-0.417**	-0.437**	-0.486**	1.000		
7. Peer support	-0.507**	-0.502**	-0.463**	-0.457**	-0.477**	-0.487**	1.000	
8. HRQoL	-0.366**	-0.466**	-0.444**	-0.468**	-0.519**	-0.442**	-0.408**	1.000

Note. HRQoL = Health-related quality of life; All correlations are significant at the level of $^{**}p < 0.01$

Model testing

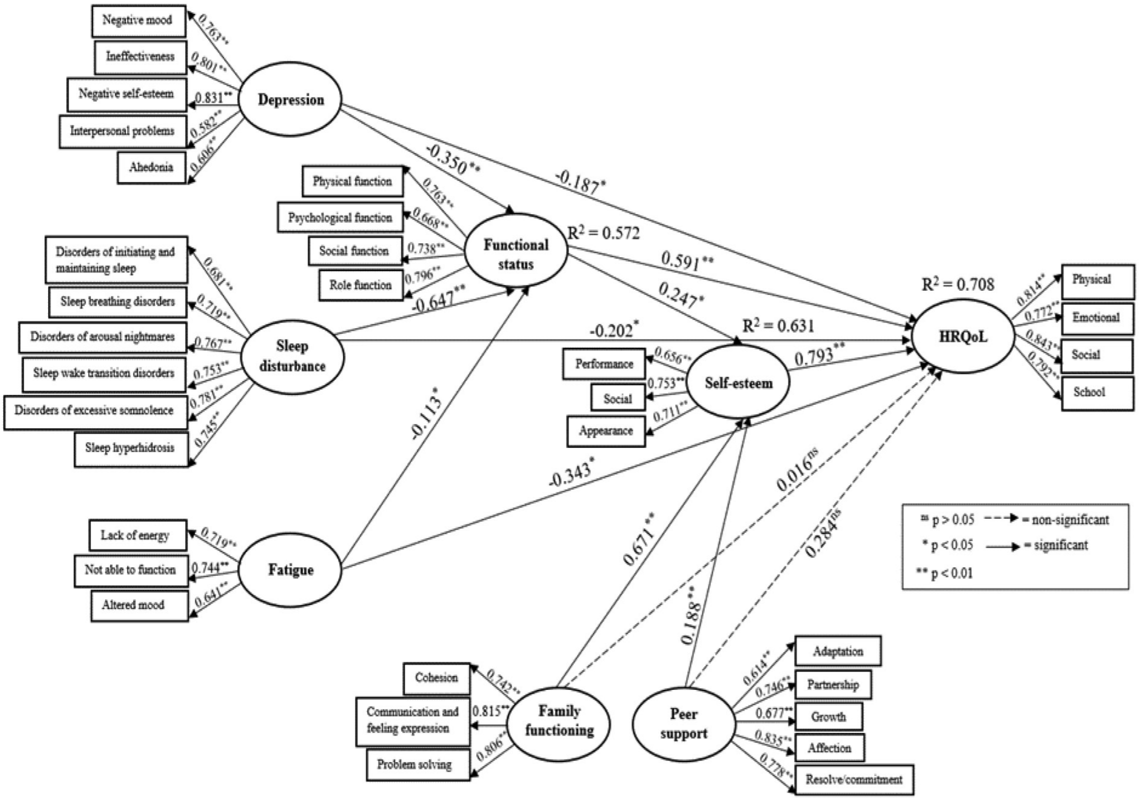
Measurement model assessment: First, construct validity for the eight latent variables was examined using confirmatory factor analysis (CFA). These findings demonstrated that each of the eight constructs attained an acceptable level of model fit, thereby confirming the construct validity in alignment with the underlying theoretical framework (**Table 3**).

Table 3. Summary of fit statistics for the measurement model variables in confirmatory factor analysis

Goodness-of-fit indices	Variables							
	FT	SD	DP	FS	SE	FF	PS	HRQoL
χ^2	0.653	10.666	1.840	0.300	4.471	2.39	3.94	1.929
Degree of freedom	1	6	4	1	3	2	4	1
χ^2/df	0.653	1.778	0.460	0.300	1.490	1.195	0.985	1.929
p-value	0.419	0.099	0.765	0.584	0.215	0.302	0.414	0.165
RMSEA	0.000	0.038	0.000	0.000	0.031	0.020	0.000	0.042
SRMR	0.029	0.015	0.007	0.002	0.029	0.013	0.012	0.008
CFI	1.000	0.997	1.000	1.000	0.997	0.999	1.000	0.999
TLI	1.000	0.992	1.000	1.000	0.997	0.999	1.000	0.995

Note. The latent variables: Fatigue (FT), Sleep disturbance (SD), Depression (DP), Functional status (FS), Self-esteem (SE), Family functioning (FF), Peer support (PS); HRQoL = Health-related quality of life; The fit indices: χ^2 (Chi-square), χ^2/df (relative chi-square); RMSEA = Root mean square error of approximation; SRMR = Standardized root mean square residual; CFI = Comparative fit index; and TLI = Tucker-Lewis index

Structural model assessment: Next, the structural relationships within the proposed model of HRQoL among Thai ASoCC (**Figure 1**) were examined. Upon evaluating the preliminary theoretical model, the generated fit statistics indicated that the original model did not satisfy the established fit criteria (**Table 4**). Consequently, model modification was necessary. This was accomplished by incorporating paths with bidirectional arrows to permit the correlation of errors, guided by modification indices and focusing on constructs with the highest error values reported by the program. The modified model of HRQoL among Thai ASoCC achieved the strongest fit with the empirical data; all fit indices met the required standards (see **Table 4**). The results of this structural testing are illustrated in **Figure 3**.



Fit indices included χ^2/df at 1.925, p-value at 0.071, RMSEA at 0.028, SRMR at 0.025, CFI at 0.987, and TLI at 0.978

Figure 3. The final structural equation model (SEM) results illustrating the hypothesized relationships for HRQoL among Thai ASoCC

Table 4. The comparison of fit statistics between the hypothesized and modified models of HRQoL among Thai adolescent survivors of childhood cancer

Goodness of fit indices	Standard of fit	Hypothesized model	Modified model
Relative Chi-square (χ^2/df)	≤ 3.00	4.214	1.925
P-value	> 0.05	0.000	0.071
Root Mean Square Error of Approximation (RMSEA)	≤ 0.08	0.095	0.028
Standardized Root Mean Square Residual (SRMR)	< 0.10	0.091	0.025
Comparative Fit Index (CFI)	≥ 0.90	0.753	0.987
Tucker-Lewis Index (TLI)	≥ 0.90	0.724	0.978

Final model interpretation: From this revised structural model (**Figure 3**), it was found that fatigue, sleep disturbance, and depression exerted negative direct and indirect influences upon HRQoL, channeling effects both through the functional status mediator, and via the sequential pathway involving functional status and self-esteem. Functional status exhibited positive direct and indirect impacts on HRQoL through self-esteem. Family functioning and peer support showed no positive direct impact but did demonstrate an indirect influence on HRQoL through the mediation of self-esteem. Self-esteem, in turn, demonstrated a positive direct influence on HRQoL and had the strongest overall effect. These seven predictors collectively accounted for 70.80% of the variance in HRQoL (**Table 5**).

Table 5. Reporting the direct (DE), indirect (IE), and total (TE) effects, alongside the multi-relative coefficient (R^2), for health-related quality of life in Thai ASoCC

Endogenous variables	R^2	Influencing variables	DE	IE	TE
HRQoL	0.708	Fatigue	-0.343*	-0.067*	-0.410*
		Sleep disturbance	-0.202*	-0.382**	-0.584*
		Depression	-0.187*	-0.241**	-0.428**
		Functional status	0.591**	0.196**	0.787*
		Self-esteem	0.793**	-	0.793**
		Family functioning	0.016	0.532**	0.548**
		Peer support	0.284	0.149**	0.433**
Self-esteem	0.631	Functional status	0.247*	-	0.247*
		Family functioning	0.671**	-	0.671**
		Peer support	0.188**	-	0.188**
Functional status	0.572	Fatigue	-0.113*	-	-0.113*
		Sleep disturbance	-0.647**	-	-0.647**
		Depression	-0.350**	-	-0.350**

Note. The level of statistical significance is denoted with these conventions: *$p < 0.05$, **$p < 0.01$

Discussion

The finalized causal model, which examined the relationships among influencing factors and HRQoL among Thai ASoCC, mostly supported the hypothesis and the revised WCM. The findings indicated that fatigue, sleep disturbance, and depression directly and indirectly affect HRQoL through functional status and self-esteem. Functional status directly and indirectly affects HRQoL through self-esteem. Self-esteem directly affects HRQoL. However, family functioning and peer support were found to have no direct effect on HRQoL but rather to affect HRQoL indirectly through self-esteem. All factors can explain 70.8% of the variance in HRQoL, which is relatively high.

Fatigue, sleep disturbance, and depression directly and indirectly affected HRQoL through functional status and self-esteem. This may be because ASoCC experience fatigue, sleep disturbance, and depression, which are late effects of cancer and its treatment. They may have less energy, feel more tired, experience excessive daytime sleepiness, and feel very sad, all of which directly affect their lives. When ASoCC cannot live a normal life, they therefore perceive their HRQoL as poor. These results were in line with previous studies.[14,16,18] In addition, fatigue, sleep disturbance, and depression affect the ability of ASoCC to perform tasks in daily life, leading to impaired functional status. ASoCC with impaired functional status are unable to perform physical, psychological, social, and role function, which affects all aspects of their lives, leading to poor HRQoL. These findings were consistent with previous studies.[15,17,22] Moreover, adolescence is a time when adolescents want to take responsibility for themselves, seek freedom, and build a sense of self-esteem.[1] When ASoCC with fatigue, sleep disturbance, and depression had impaired functional status, they were unable to perform tasks on their own. They became more dependent on others, which made them feel worthless and led to low self-esteem. ASoCC with low self-esteem may experience a negative self-perception, leading to decreased confidence in performing daily activities, have negative feelings like shame and guilt, have social withdrawal, and have less engagement in studies, which affects their lives, leading to poor HRQoL. These findings align with prior studies.[21,26,27]

Functional status directly and indirectly affected HRQoL through self-esteem. This may be because functional status represents an individual's capability to execute necessary activities and tasks.[19] It can be implied that ASoCC with good functional status will be able to live a normal life, leading to a good HRQoL. In contrast, ASoCC with impaired functional status are unable to live productively, resulting in a poor HRQoL. This finding aligns with a prior study.[22] In addition, ASoCC with poor functional status feel like a burden to others, feel worthless, and have low self-esteem, which affects their lives, leading to a poor HRQoL. This result is similar to previous studies.[21,26,27]

Family functioning indirectly affected HRQoL through self-esteem. This may be because good family functioning provides a supportive environment that fosters a sense of self-worth, assurance, and resilience in ASoCC. Supportive family relationships help ASoCC feel valued and capable, which can mitigate the impact of cancer and its treatment on their self-esteem, resulting in increased self-esteem.[30] ASoCC with high self-esteem will have a positive self-perception, leading to increased confidence in performing daily functions, have positive emotional states, have greater social engagement, and have improved school performance, which promotes their lives, leading to a better HRQoL. Therefore, ASoCC who live in families with good family functioning have higher self-esteem and a better HRQoL. This finding was in line with previous studies.[26,27,30]

Peer support indirectly affected HRQoL through self-esteem. This may be because ASoCC consider their peers as a major source of emotional backup. This kind of support involves actions that enhance emotional health, such as active listening, demonstrating affection, appreciation, and acceptance, which collectively reinforce self-esteem.[33] Thus, ASoCC with good peer support have high self-esteem, resulting in good HRQoL. This result has been confirmed in previous studies.[26,27,33]

Self-esteem directly affected HRQoL. This may be because self-esteem is an overall evaluation of a person's thoughts and feelings regarding self-worth.[23] ASoCC with high self-esteem have a positive self-perception, which leads to enhanced confidence in daily tasks, pleasant emotional states, more social involvement, and improved academic performance, all of which improve their lives and lead to a higher HRQoL. On the contrary, ASoCC with low self-esteem have a negative view of themselves, which makes them less confident in carrying out everyday tasks, experience negative emotions, withdraw socially, and participate less in their studies, all of which have an impact on their lives and lead to a low HRQoL. This finding was consistent with prior studies.[26,27]

Family functioning and peer support did not directly affect HRQoL. This may be because most participants in this study completed cancer treatment 3-6 years ago, a relatively long time. During the acute survivorship phase, the cancer diagnosis and treatment take center stage, and the child's needs are often prioritized. Once treatment concludes, the focus can shift; family members and peers of ASoCC may assume the ASoCC are "cured," are able to live an everyday life, and no longer require the same level of care and support.[8] Therefore, they have changed to take care of and support ASoCC in general matters, without focusing on care and support for the lives of ASoCC affected by cancer and its treatment as before. This explanation may account for why family functioning and peer support did not directly influence HRQoL.

Limitations

This study utilized a cross-sectional approach, meaning that all variables were assessed simultaneously. It limited the ability to make causal inferences. Therefore, the study findings should be considered as tentative until further data from longitudinal or experimental studies are available. Since the data for this research were gathered at four tertiary hospitals across three regions of Thailand, generalizations regarding ASoCC in other parts of the country should be made with caution. In addition, data collection in four hospitals took a long time because the PI had to wait for full board research ethics approval from each hospital before collecting data. Moreover, the questionnaires in this study were lengthy, which may have made respondents feel tired and less focused, leading to inaccurate answers.

Conclusions and Implications for Nursing Practice

The causal model of HRQoL among Thai ASoCC developed in this study fit with the empirical data, and all variables together explain 70.80% of HRQoL. This developed model clearly explains the direct and indirect effects of fatigue, sleep disturbance, depression, functional status, self-esteem, family functioning, and peer support on HRQoL. Since self-esteem had the strongest influence on HRQoL, nurses can use the findings in designing interventions that emphasize promoting self-esteem to enhance HRQoL by educating and encouraging ASoCC to use effective symptom management strategies to reduce fatigue, sleep disturbances, and depression, which will help them to have a better functional status, resulting in increased self-esteem. In addition, promoting good family functioning among ASoCC's family members, especially by strengthening family cohesion and providing peer support groups to offer emotional support to ASoCC, can help them develop higher self-esteem. Developing interventions that promote self-esteem could help ASoCC improve their HRQoL. However, the interventions should be further tested for effectiveness before implementation.

Author Contributions

Conception and design: B.S., J.M., S.N., P.T.
Data collection and analysis: B.S.
Writing-original draft preparation: B.S., J.M.
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แบบจำลองเชิงสาเหตุของคุณภาพชีวิตด้านสุขภาพในวัยรุ่นไทยที่รอดชีวิตจากโรคมะเร็งในวัยเด็ก : การศึกษาภาคตัดขวาง

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บทคัดย่อ : การยกระดับคุณภาพชีวิตด้านสุขภาพในกลุ่มวัยรุ่นที่รอดชีวิตจากโรคมะเร็งในวัยเด็กกำลังเป็นประเด็นสำคัญสำหรับบุคลากรทางการแพทย์ เพื่อการออกแบบโปรแกรมที่มีประสิทธิภาพซึ่งจะช่วยยกระดับคุณภาพชีวิตด้านสุขภาพนี้ การทำความเข้าใจปัจจัยที่เกี่ยวข้องและกลไกที่ปัจจัยเหล่านั้นส่งอิทธิพลต่อคุณภาพชีวิตด้านสุขภาพของพวกเขาจึงเป็นเรื่องสำคัญยิ่ง การวิจัยแบบภาคตัดขวางนี้มีวัตถุประสงค์เพื่อพัฒนาและทดสอบแบบจำลองเชิงสาเหตุของคุณภาพชีวิตด้านสุขภาพในกลุ่มวัยรุ่นไทยที่รอดชีวิตจากโรคมะเร็งในวัยเด็ก โดยได้เก็บรวบรวมข้อมูลจากวัยรุ่นไทยที่รอดชีวิตจากโรคมะเร็งในวัยเด็กจำนวน 473 คน จากโรงพยาบาลระดับตติยภูมิจำนวน 4 แห่งในประเทศไทย โดยใช้แบบสอบถาม 9 ฉบับ ได้แก่ แบบสอบถามข้อมูลส่วนบุคคล แบบประเมินอาการอ่อนเปลี้ยในเด็ก แบบสอบถามอาการนอนหลับแปรปรวนสำหรับเด็ก แบบวัดภาวะซึมเศร้าในเด็ก แบบประเมินภาวะการทำหน้าที่ แบบประเมินความภาคภูมิใจในตนเอง แบบวัดการทำหน้าที่ของครอบครัวไทย แบบสอบถามแรงสนับสนุนจากเพื่อน และแบบสอบถามคุณภาพชีวิตสำหรับเด็ก วิเคราะห์ข้อมูลเบื้องต้นด้วยสถิติพรรณนาตามด้วยการสร้างแบบจำลองสมการโครงสร้างด้วยโปรแกรม Mplus

แบบจำลองสุดท้ายที่สอดคล้องกับข้อมูลการวิจัยสามารถอธิบายความแปรปรวนของคุณภาพชีวิตด้านสุขภาพได้ร้อยละ 70.80 โดยอาการอ่อนเปลี้ย อาการนอนหลับแปรปรวน ภาวะซึมเศร้า และภาวะการทำหน้าที่มีอิทธิพลทั้งทางตรงและทางอ้อมต่อคุณภาพชีวิตด้านสุขภาพ ส่วนการทำหน้าที่ของครอบครัวและการสนับสนุนจากเพื่อน พบว่ามีเพียงอิทธิพลทางอ้อมต่อคุณภาพชีวิตด้านสุขภาพผ่านความภาคภูมิใจในตนเองเท่านั้น ความภาคภูมิใจในตนเองมีอิทธิพลทางตรงต่อคุณภาพชีวิตด้านสุขภาพและเป็นปัจจัยที่มีอิทธิพลสูงสุด ดังนั้น พยาบาลสามารถออกแบบโปรแกรมที่เน้นการส่งเสริมความภาคภูมิใจในตนเอง การให้ความรู้และการส่งเสริมให้วัยรุ่นที่รอดชีวิตจากโรคมะเร็งในวัยเด็กใช้กลยุทธ์การจัดการอาการที่มีประสิทธิภาพเพื่อลดอาการอ่อนเปลี้ย อาการนอนหลับแปรปรวน และภาวะซึมเศร้า ซึ่งช่วยให้มีภาวะการทำหน้าที่ที่ดีขึ้น ควบคู่ไปกับการส่งเสริมการทำหน้าที่ของครอบครัวที่ดี และการจัดกลุ่มสนับสนุนจากเพื่อนจะช่วยเพิ่มความความภาคภูมิใจในตนเอง และนำไปสู่การมีคุณภาพชีวิตด้านสุขภาพที่สูงขึ้นในประชากรกลุ่มนี้

Pacific Rim Int J Nurs Res 2026; 30(1) 221-237

คำสำคัญ : วัยรุ่นผู้รอดชีวิต โรคมะเร็งในวัยเด็ก การทำหน้าที่ของครอบครัว ภาวะการทำหน้าที่ คุณภาพชีวิตด้านสุขภาพ การสนับสนุนจากเพื่อน ความภาคภูมิใจในตนเอง

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