Health-Related Quality of Life in Patients With Coronary Artery Disease Undergoing Percutaneous Coronary Intervention: A Cross-Sectional Study

Yujeong KIM

ABSTRACT

Background: The percutaneous coronary intervention (PCI) is the most common treatment for coronary artery disease. Health-related quality of life (HRQoL), alongside mortality and recurrence rates, is a key outcome indicator for PCI.

Purpose: The aim of this study was to investigate the factors influencing HRQoL in patients with coronary artery disease who had received PCI.

Methods: A convenience sample from the cardiovascular center of a tertiary hospital in South Korea was recruited for this descriptive, cross-sectional study. This study was conducted using a structured questionnaire and patients' medical records on a sample of 210 patients with coronary artery disease who were ≥ 18 years old and > 1 month post-PCI. The questionnaire collected information on general, clinical, and psychosocial characteristics. Data were analyzed using descriptive statistics, independent t test, one-way analysis of variance, the Scheffé test, and the Pearson correlation test. A multiple linear regression, together with the significant variables in univariate analysis, was used to determine the variables that significantly influenced HRQoL.

Results: HRQoL was found to vary significantly with age, marital status, subjective economic status, primary caregiver, duration since first PCI, New York Heart Association class, anxiety, depression, and social support. The significant general characteristics shown to affect HRQoL in patients who had undergone PCI included age, marital status, and primary caregiver. The significant clinical characteristics shown to affect HRQoL included duration from first PCI and New York Heart Association class. The significant psychosocial characteristics shown to affect HRQoL included anxiety and depression. Primary caregiver and New York Heart Association class were identified as having the greatest impact on HRQoL in the PCI patients in this study.

Conclusions: To enhance HRQoL in patients who had received PCI, their post-PCI physical and psychological symptoms should be regularly assessed. Furthermore, intervention strategies aimed to improve quality of life in patients with severe functional limitations and those receiving family care are necessary.

KEY WORDS: quality of life, percutaneous coronary intervention, coronary artery disease.

Introduction

Heart disease is the second leading cause of death in Korea after cancer, and the mortality rate from coronary artery diseases (CADs) such as angina and myocardial infarction was 28.3 per 100,000 persons in 2018 (Korean Statistical Information Service, 2018). CAD narrows coronary arteries, which impairs myocardial blood flow (Sidik et al., 2019). In addition to drug therapy, percutaneous coronary interventions (PCIs) such as balloon dilation or stent placement are the most common treatment for CAD, accounting for > 80% of total CAD-related procedures. In Korea, more than 65,000 PCI procedures are performed at about 140 hospitals every year (Healthcare Bigdata Hub, 2020).

PCI offers several advantages over coronary artery bypass grafting (CABG), including faster recovery, more immediate clinical improvement, higher success rate, and lower postoperative mortality rate (Moreno et al., 2020). Furthermore, although the occurrence of in-stent restenosis of bare metal stents is 16–44%, the newly introduced drug-eluting stent has reduced the restenosis rate to 5%–15% (Liou et al., 2016). However, the incidence rate of restenosis is 10%–20% in patients with long lesions, small vessels, diabetes, ostial lesions, or side branch lesions (Suzuki et al., 2018). In addition, the risk of sudden death in patients undergoing PCI is 4–6 times that in the general population (Zaman & Kovoor, 2014). Therefore, even after receiving PCI, decreased health-related quality of life (HRQoL) in these patients in terms of activity restrictions, emotional instability, and decreased social activity has been reported (Murphy et al., 2019).

For patients who have received PCI, HRQoL, along with mortality and recurrence rates, is a key outcome indicator (Van Nguyen et al., 2021). Several clinical variables that...
influence HRQoL in these patients have been reported, including number of comorbidities (e.g., diabetes, hyperlipidemia, and hypertension), number of diseased vessels, number of PCI procedures, left ventricular contraction rate, and levels of physical activity (Höfer et al., 2005; Rantanen et al., 2008). In addition, high levels of anxiety have been observed in patients undergoing PCI (Murphy et al., 2019), with HRQoL found to be negatively correlated with the levels of depression and anxiety in patients undergoing PCI treatment (Liu et al., 2018). Furthermore, HRQoL is significantly affected by psychosocial factors, including support from family and society (Li et al., 2019). However, few studies in which the factors in different aspects have been identified while considering clinical, general, and psychosocial factors that influence postoperative HRQoL in patients undergoing PCI have been conducted. Therefore, this study was designed to identify the factors that influence postoperative HRQoL in patients with CAD undergoing PCI and to provide evidence useful to the development of patient education and intervention programs.

Methods

Design

This cross-sectional study was designed to identify the factors that influence HRQoL in patients with CAD who receive PCI.

Study Population

This study involved subjects who, after undergoing their PCI procedure, received outpatient follow-up care at the cardiovascular center of a tertiary hospital in Korea and agreed to complete a questionnaire after giving informed consent. On the basis of the finding of a prior study that half of patients returned to work within 4 weeks of receiving a PCI procedure (Smedegaard et al., 2017), this study included patients aged ≥18 years who had received a PCI procedure at least 4 weeks before recruitment. Otherwise, qualified individuals who had undergone coronary angiography or CABG only were excluded. A sample size of 179 participants was calculated using the G*Power 3.1 program (effect size = .15, power = .9, α = .05, and number of predictors = 17), and after adding a dropout buffer, data were collected from 215 participants. After excluding five participants for incomplete questionnaire submissions, data from 210 participants were included in the analysis.

Data Collection Methods

Data collection was performed after receiving approval from the hospital’s institutional review board (No. H-1401-038-548). A questionnaire was administered to the patients by the researcher and two research assistants who were trained in advance by the researcher with regard to the questionnaire content and distribution methods. Data were collected from February 7 to 27, 2014. All of the participants were briefed about the objectives of the research and voluntarily signed informed consent. Each participant completed the questionnaire in about 15 minutes, receiving a small gift afterward as a token of appreciation. Clinical information, including diagnosis, time of diagnosis, number of diseased vessels, number of comorbidities, and numbers and duration of PCI, was obtained from patient medical records after approval had been received from the hospital medical information center.

Instruments

General characteristics

Data on the gender, age, marital status, level of education, perceived economic status, job, and primary caregiver of the participant were investigated in this study.

Clinical characteristics

Participants' clinical information, including diagnosis, time of diagnosis, number of PCI procedures, number of diseased vessels, duration since first PCI, number of comorbidities, left ventricular ejection fraction (LVEF), and New York Heart Association (NYHA) class, were collected using a review of individual medical records. For diagnosis, this study focused on angina and myocardial infarction among CADs. The number of PCI procedures was defined as the number of times a participant had undergone a PCI procedure. The number of diseased vessels was defined as the total number of coronary arteries identified to have narrowed between the time of diagnosis and the time of this research. Blood vessel invasion was defined as a > 50% narrowing of coronary arteries. Duration since first PCI was defined as the period between the first PCI and the time of this research. The number of comorbidities was defined as the total number of comorbid conditions, including diabetes, hypertension, hyperlipidemia, stroke, kidney failure, peripheral vascular disease, congestive heart failure, and chronic obstructive pulmonary disease. LVEF refers to the measure taken during the latest echocardiography or cardiac catheterization after PCI, with the resulting value expressed as the median for each range. The NYHA class was measured using the NYHA functional classification system, which divides physical activity in patients with heart failure into four levels. Class I describes no symptoms during daily activity; Class II indicates slight limitation during daily activity, with no symptoms at rest; Class III represents no symptoms at rest, with mild symptoms during daily activity; and Class IV elucidates symptoms (breathing difficulties or angina) even at rest. A higher level indicates a more severe limitation of physical activity (Criteria Committee of the NYHA, 1994).

Psychosocial characteristics

Anxiety, depression, and social support were used to assess the psychosocial characteristics of the participants.
Anxiety and depression
Levels of anxiety and depression were measured in this study using the Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983) standardized for Koreans by Oh et al. (1999). The Korean versions of the anxiety and depression subscales were distributed by the licensor GL Assessment after approval, and a user fee was paid. The Hospital Anxiety and Depression Scale is a 14-item, self-administered questionnaire, with seven odd-numbered items used to measure anxiety symptoms and seven even-numbered items used to measure depression symptoms. The Hospital Anxiety and Depression Scale uses a 4-point rating scale, with 0 representing “none” and 3 representing “severe” and a total possible score range of 0–21 for each subscale. A score of ≥ 8 indicates significant anxiety or depression, with higher scores correlated with greater anxiety/depression severity. For the translated version of this subscale, Oh et al. reported Cronbach’s α scores of reliability for anxiety and depression of .89 and .86, respectively. In this study, the Cronbach’s α scores were .85 and .79, respectively.

Social support
Level of social support was measured in this study using the multidimensional scale of perceived social support developed by Zimet et al. (1988). Permission was obtained to use this instrument from the corresponding author. This questionnaire consists of 12 items and is used to assess the levels of special support received from family, friends, and others (i.e., doctors, nurses, and other healthcare professionals). Each item is rated on a 5-point scale, with 1 representing “not at all” and 5 representing “strong agreement.” The total possible mean score range is 1–5, with higher scores indicating greater social support. Cronbach’s α of .83 was the original reported reliability of this instrument, and the Cronbach’s α in this study was .92.

Health-related quality of life
HRQoL was measured in this study using the Seattle Angina Questionnaire (SAQ) developed and modified by Spertus et al. (2002). The Korean version of the questionnaire developed by Cardiovascular Outcomes Inc. was distributed after that company’s approval and the payment of a user fee. The SAQ comprises four domains: physical limitation, angina frequency, and HRQoL. As each domain is independent, only domain scores were calculated, with no total or mean domain scores calculated. The HRQoL domain was specifically used in this study to measure HRQoL. This domain uses a 5-point Likert scale, with item scores summed and converted to a scale of 100, with possible total scores ranging from 0 to 100 and higher scores indicating better HRQoL. Instrument reliability was reported as Cronbach’s α of .78 at the time of development and as .76 in this study.

Data Analysis
The collected data were analyzed using IBM SPSS Statistics 22.0 (IBM Inc., Armonk, NY, USA). General characteristics of the participants were expressed as frequencies, percentages, mean, and standard deviations using descriptive statistics. The relationship between HRQoL and participant characteristics was analyzed using the independent t test, one-way analysis of variance, and Scheffé test. Cronbach’s α was used as a measure of reliability of the instruments. A multiple linear regression, together with the significant variables from the univariate analysis, was used to determine the variables influencing HRQoL in the participants.

Results
General Characteristics
One hundred fifty-six men (74.3%) and 54 women (25.7%) participated in this study. The overall mean age was 68.94 years (SD = 9.22); 192 (91.4%) were married; 81 (38.5%) were educated to the high school level, and 73 (34.8%) had completed education above the high school level; 107 (51.0%) perceived their economic status as moderate; and 176 (83.8%) were not currently employed. In addition, 99 participants (47.1%) cited their spouse as the primary caregiver, and 83 (40.5%) practiced self-care (Table 1).

Clinical Characteristics
Angina and myocardial infarction were observed in 141 participants (67.1%) and 69 participants (32.9%), respectively; 163 (77.6%) had undergone one PCI procedure only; and 84 (40.0%; the largest group) had one diseased vessel. In terms of duration since first PCI, 79 participants (37.6%; the largest group) had received their first PCI over 7 years ago, and the mean duration for all participants was 5.52 years (SD = 4.20). Furthermore, 83 participants (39.5%) had two comorbidities, 62 (29.5%) had one comorbidity, and 59 (28.1%) had three or more comorbidities. One hundred seventy-three (82.4%) had an LVEF value > 50%, and 24 (11.4%) had an LVEF value of 40%–50%. In terms of NYHA classification, 156 participants (74.3%) were classified in Class I and 47 (22.4%) were in Class II (Table 1).

Psychosocial Characteristics
The participants earned the following respective mean scores for anxiety, depression, and social support: 4.61 (SD = 3.84), 7.69 (SD = 4.06), and 3.62 (SD = 0.62; see Table 1).

Relationship Between Health-Related Quality of Life and Participant Characteristics
The overall mean HRQoL score of the participants was 71.71. In terms of general characteristics, HRQoL significantly varied by age, marital status, subjective economic status, and primary caregiver. HRQoL was significantly higher among participants aged ≥ 55 years than among younger participants ($F = 4.62, p = .004$), among those who were
Table 1
The General, Clinical, and Psychosocial Characteristics of Participants and Differences in Health-Related Quality of Life (N = 210)

| Category                        | n   | %       | HRQoL M | HRQoL SD | t/F   | p       | Scheffé |
|---------------------------------|-----|---------|---------|---------|-------|---------|---------|
| **General characteristics**     |     |         |         |         |       |         |         |
| Gender                          |     |         |         |         |       |         |         |
| Male                            | 156 | 74.3    | 78.33   | 16.46   | 1.40  | .163    |         |
| Female                          | 54  | 25.7    | 74.57   | 18.64   |       |         |         |
| Age (years; M and SD)           |     |         |         |         |       |         |         |
| ≤ 54                            | 15  | 7.1     | 63.11   | 22.52   | 4.62  | .004    | ②, ③, ④ > ① |
| 55–64                           | 44  | 21.0    | 77.88   | 16.00   |       |         |         |
| 65–74                           | 92  | 43.8    | 80.15   | 14.89   |       |         |         |
| ≥ 75                            | 59  | 28.1    | 76.27   | 18.04   |       |         |         |
| Marital status                  |     |         |         |         |       |         |         |
| Single                          | 6   | 2.9     | 77.78   | 12.41   | 4.81  | .009    | ② > ①, ③ |
| Widowed or separated            | 12  | 5.7     | 62.78   | 16.51   |       |         |         |
| Married                         | 192 | 91.4    | 78.26   | 16.51   |       |         |         |
| Level of education              |     |         |         |         |       |         |         |
| Below elementary school         | 26  | 12.4    | 75.13   | 18.53   | 0.18  | .909    |         |
| Middle school                   | 30  | 14.3    | 77.11   | 17.63   |       |         |         |
| High school                     | 81  | 38.5    | 77.86   | 16.73   |       |         |         |
| College or above                | 73  | 34.8    | 77.72   | 16.93   |       |         |         |
| Perceived economic status       |     |         |         |         |       |         |         |
| Low                             | 28  | 13.3    | 69.52   | 18.72   | 3.53  | .031    | ②, ③ > ① |
| Moderate                        | 107 | 51.0    | 78.26   | 18.05   |       |         |         |
| High                            | 75  | 35.7    | 79.02   | 14.23   |       |         |         |
| Employed                        |     |         |         |         |       |         |         |
| No                              | 176 | 83.8    | 77.20   | 17.00   | 0.32  | .746    |         |
| Yes                             | 34  | 16.2    | 78.24   | 17.78   |       |         |         |
| Primary caregiver               |     |         |         |         |       |         |         |
| Spouse                          | 99  | 47.1    | 76.16   | 17.15   | 6.64  | < .001  | ①, ② > ①, ② |
| Children                        | 20  | 9.5     | 64.00   | 20.45   |       |         |         |
| Self                            | 85  | 40.5    | 81.73   | 14.89   |       |         |         |
| Others                          | 6   | 2.9     | 80.00   | 13.98   |       |         |         |
| **Clinical characteristics**    |     |         |         |         |       |         |         |
| Diagnosis                       |     |         |         |         | -1.69 | .093    |         |
| Angina                          | 141 | 67.1    | 75.98   | 17.36   |       |         |         |
| Myocardial infarction           | 69  | 32.9    | 80.19   | 16.25   | 0.64  | .530    |         |
| Number of PCI                   |     |         |         |         |       |         |         |
| 1                               | 163 | 77.6    | 77.88   | 16.84   | 0.64  | .530    |         |
| 2                               | 37  | 17.6    | 76.22   | 18.34   |       |         |         |
| ≥ 3                             | 10  | 4.8     | 72.00   | 18.00   |       |         |         |
| Number of diseased vessels      |     |         |         |         |       |         |         |
| 1                               | 84  | 40.0    | 77.94   | 17.53   | 0.11  | .893    |         |
| 2                               | 60  | 28.6    | 76.56   | 17.81   |       |         |         |
| ≥ 3                             | 66  | 31.4    | 77.37   | 16.03   |       |         |         |
| Duration since first PCI (years; M and SD) |     |         |         |         | 5.52  | 4.20    | 3.74    | .012   | ② > ①, ② |
| < 1                             | 31  | 14.8    | 72.81   | 19.07   |       |         |         |
| 1–3                             | 51  | 24.3    | 72.73   | 17.89   |       |         |         |
| 4–6                             | 49  | 23.3    | 78.37   | 16.64   |       |         |         |
| ≥ 7                             | 79  | 37.6    | 81.52   | 14.91   |       |         |         |

(continues)
married than among those who had never married or were widowed \((F = 4.81, p = .009)\), among those who perceived their economic status to be moderate \((F = 3.53, p = .031)\), and among those who practiced self-care or relied on non-family caregivers than among those with a family caregiver \((F = 6.64, p < .001)\).

In terms of clinical characteristics, HRQoL varied significantly by duration since first PCI and NYHA class. HRQoL was significantly higher among participants whose first PCI was \(\geq 7\) years ago than among those who had received PCI more recently \((F = 3.74, p = .012)\). HRQoL was also significantly higher in those classified as NYHA Class I \((F = 9.91, p < .001)\).

In terms of psychosocial characteristics, HRQoL varied significantly with all three measures, namely, anxiety, depression, and social support. With regard to anxiety and depression, participants with scores < 8 had a higher HRQoL than those with scores \(\geq 8\) \((t = 4.47, p < .001\), for anxiety; \(t = 3.64, p < .001\), for depression). With regard to social support, participants with higher perceived social support reported a significantly higher HRQoL than those with lower perceived social support \((F = 3.18, p = .044; \text{Table 1})\).

### Table 1
The General, Clinical, and Psychosocial Characteristics of Participants and Differences in Health-Related Quality of Life \((N = 210)\), Continued

| Category                                | \(n\) | %    | HRQoL | \(t/F\) | \(p\) | Scheffé |
|-----------------------------------------|-------|------|-------|---------|-------|---------|
| **Number of comorbidities**             |       |      |       |         |       |         |
| 0                                       | 6     | 2.9  | 71.11 | 14.40   | 0.33  | .801    |
| 1                                       | 62    | 29.5 | 76.99 | 17.93   |       |         |
| 2                                       | 83    | 39.5 | 78.15 | 17.24   |       |         |
| \(\geq 3\)                               | 59    | 28.1 | 77.29 | 16.43   |       |         |
| **Left ventricular ejection fraction (%)** |     |      |       |         |       |         |
| > 50                                    | 173   | 82.4 | 84.54 | 14.16   | 0.08  | .919    |
| 40–50                                   | 24    | 11.4 | 85.42 | 14.74   |       |         |
| < 40                                    | 8     | 3.8  | 83.13 | 13.61   |       |         |
| **NYHA class**                          |       |      |       |         |       |         |
| \(\text{① I} \)                         | 156   | 74.3 | 80.17 | 15.81   | 9.91  | < .001  |
| \(\text{② II} \)                        | 47    | 22.4 | 70.50 | 18.00   |       |         |
| \(\text{③ \(\geq III\)} \)             | 7     | 3.3  | 60.95 | 18.23   |       |         |
| **Psychosocial characteristics**        |       |      |       |         |       |         |
| Anxiety \((M \text{ and } SD)\)         | 4.61  | 3.84 |       |         | 4.47  | < .001  |
| \(< 8\)                                 |       |      | 80.00 | 15.76   |       |         |
| \(\geq 8\)                              |       |      | 67.70 | 18.42   |       |         |
| Depression \((M \text{ and } SD)\)      | 7.69  | 4.06 |       |         | 3.64  | < .001  |
| \(< 8\)                                 |       |      | 81.62 | 16.29   |       |         |
| \(\geq 8\)                              |       |      | 77.02 | 16.90   |       |         |
| Social support \((M \text{ and } SD)\)  | 3.62  | 0.62 |       |         | 3.18  | .044    |
| \(\text{① Low (1–2.9)} \)              |       |      | 72.62 | 18.18   |       |         |
| \(\text{② Moderate (3–4)} \)           |       |      | 82.42 | 14.74   |       |         |
| \(\text{③ High (4.1–5)} \)             |       |      | 96.71 | 17.28   |       |         |

Note. HRQoL = health-related quality of life; PCI = percutaneous coronary intervention; NYHA = New York Heart Association.

Factors Influencing Health-Related Quality of Life

Multiple regression analyses were performed to determine the factors influencing HRQoL in the participants based on independent variables, which included all of the general, clinical, and psychosocial characteristics (Table 2). In the multiple regression analyses, the presence of autocorrelation and multicollinearity among the independent variables was examined. The Durbin–Watson statistic was 2.05, indicating that the variables are independent without autocorrelation as it is close to the criterion value of 2. The tolerance value exceeded \(\geq .1\) in the range of \(.67–.95\). A variance inflation factor was used to detect multicollinearity among the independent variables, and the resulting value was less than 10 in the range of \(1.05–1.51\), indicating the absence of multicollinearity.

The multiple regression analyses revealed age \((\beta = .16)\), marital status \((\beta = .13)\), primary caregiver \((\beta = .19)\), duration since first PCI \((\beta = .15)\), NYHA class \((\beta = -.19)\), anxiety \((\beta = -.17)\), and depression \((\beta = -.18)\) as the factors influencing HRQoL. No significant effect on HRQoL was found for either subjective economic status or social support. In
addition, primary caregiver and NYHA class were found to exert the greatest influence on HRQoL of all the factors identified. The explanatory power of the regression model was 29% in terms of explaining the variance in HRQoL.

Discussion

In this study, the general, clinical, and psychosocial factors that influence HRQoL in patients who had received PCI were identified. The overall mean HRQoL score in this study of 71.71 was higher than that reported by Fakhrzad et al. (2016), which targeted patients who had completed their operative condition and identifying the factors affecting the HRQoL may vary based on whether or not patients experience postoperative complications. This underlines the importance of grouping patients according to postoperative condition and identifying the factors affecting the HRQoL in each group.

An analysis of the relationship between HRQoL and participant characteristics revealed HRQoL to be significantly related to the following sociodemographic factors: age, marital status, primary caregiver, and subjective economic status. HRQoL was lower in the group of < 54 years old than in the older age group. This result differs from a previous study (De Smedt et al., 2013), which found that HRQoL decreases with age in patients with CAD. However, Lv et al. (2016) reported that young and middle-aged patients who undergo a PCI procedure may be more concerned than older patients about their life and the possible effects of the procedure on their work and social life, thus leading to relatively lower HRQoL. Therefore, support and intervention programs that incorporate counseling services should be provided to address this anxiety to prevent disease recurrence and help restore health in young and middle-aged patients who undergo PCI procedures.

In this study, HRQoL was shown to be high in married participants and in those practicing self-care. In a previous study, married subjects exhibited higher adherence to treatment after PCI, greater motivation, and better life satisfaction (Kähkönen et al., 2018). Similarly, patients with chronic heart disease found meaning in life when they took care of themselves everyday as part of their efforts to restore their health (Nordfonn et al., 2019). To encourage self-care practices and improve HRQoL in patients after PCI, sincere encouragement and support from healthcare professionals are needed. A positive correlation between subjective socioeconomic status and HRQoL was observed, which echoes the findings of a previous study (Denvir et al., 2006). Previous research reported patients with CAD of low socioeconomic status to face a higher risk of recurrence and to have a higher mortality rate (Moissl et al., 2020) and lower postoperative HRQoL (Tchicaya & Lorenz, 2016). Patients with CAD facing severe emergency conditions and having a low socioeconomic status should be targeted with special measures from the public sector to provide to them the care necessary to maintain their HRQoL.

In terms of clinical features, a significant relationship was found between HRQoL and two factors: duration since first PCI and NYHA class. Similar to the findings of this study, Blankenship et al. (2013) reported in a literature analysis that HRQoL improved for 4 years after PCI. Moreover, in another study, HRQoL was shown to improve significantly and to be sustained in the older adults after PCI (Soo Hoo et al., 2014). Postoperative outcomes of PCI need to be explored in a long-term large cohort study to track the HRQoL of patients and associated factors. In addition, greater functional limitations were found in this study to be associated with lower HRQoL, which supports the findings of previous research (Jo et al., 2016). Thus, nurses should consider functional status when assessing the symptoms and HRQoL in patients who receive PCI. Further attention and efforts from healthcare professionals are also necessary to assess and aggressively treat the symptoms of post-PCI patients to reduce their limitations in terms of activities of daily living and, eventually, improve their HRQoL.

In terms of psychosocial characteristics, a significant relationship between HRQoL and the factors of anxiety,
depression, and social support was observed in this study. CAD exerts a significant impact on the HRQoL of patients by negatively affecting physical activity and psychological well-being. PCI procedures are characterized by immediate recovery from symptoms and short hospital stays. However, the 2-year recurrence probability ranges between 19.0% and 42% unless good health is continuously maintained. Moreover, the recurrence of CAD increases the risk of sudden death. Thus, CAD may elicit a high level of anxiety in sufferers (Konstance et al., 2008). Postoperative anxiety decreases physical activity, functional ability, and HRQoL in patients with heart disease and is significantly related to related mortality. Moreover, the risk of recurrence is high in patients with myocardial infarction and high levels of anxiety (Roest et al., 2010).

The prevalence rate of depression is 15%–20% following angina and myocardial infarction, and depression has been found to negatively affect the prognoses and HRQoL in patients with CAD (Bahall et al., 2020). Moreover, depression has also been associated with risk of mortality after PCI (van Dijk et al., 2016). The 2019 American College of Cardiology/American Heart Association Guidelines on the Prevention of Cardiovascular Disease emphasize the need to make improvements for healthy lifestyles (Arnett et al., 2019). However, patients with depression typically have low compliance with medication therapy and are less interested in cardiac rehabilitation, including diet and exercise therapy (Bahall et al., 2020). Thus, further actions are necessary to prevent postoperative depression and to more effectively provide depressed patients with treatment and interventions, including exercise and nutrition.

In this study, social support was positively correlated with HRQoL. Previous studies involving patients with ischemic heart disease in Korea have also reported that social support has a significant and positive impact on HRQoL both directly and indirectly (Won & Son, 2017). Similarly, social support has been found to be associated with physical activity in patients with CAD, with greater support from family, colleagues, and healthcare professionals leading to better progress in increasing physical activity (Aliabad et al., 2014). However, an Australian CAD study by Höfer et al. (2005) and a Finnish CABG study by Rantanen et al. (2008) both reported no significant relationship between social support and HRQoL. The results regarding the relationship between social support and HRQoL vary among different studies, and the cause of these inconsistencies should be further examined to determine whether they may stem from the instruments used to measure social support or from ethnic characteristics or cultural differences.

In this study, the variables found to significantly influence the HRQoL of the participants included age, marital status, primary caregiver, duration since first PCI, NYHA class, anxiety, and depression. Of these, NYHA class and primary caregiver had the strongest influence on HRQoL. HRQoL was negatively correlated with NYHA class and was influenced by having a family caregiver (spouse and children) rather than using self-care or a nonfamily caregiver. Although HRQoL was higher in married participants in this study, a negative impact was found when the participants relied on their spouse and children because of being unable to practice self-care because of severe symptoms and impaired functional capacity. According to Chong et al. (2012), elderly patients feel stressed by their family’s nonchalant responses when they convey not feeling well after undergoing PCI, although they increasingly rely on their family as a source of motivation for life as they get older (Choi & Kim, 2014). This suggests that patients who receive PCI feel stressed over the fact that their family relationships have changed as a result of their illness. Therefore, interventions are necessary to help patients maintain a healthy lifestyle with support from their family. Nursing interventions for patients who have undergone PCI procedures include providing predischarge information and education and postdischarge telephone counseling, and these interventions reportedly help patients improve their health behaviors and self-care practices, thus increasing their life satisfaction (Baek & Son, 2015). As PCI requires only a short hospital stay, the time available to implement nursing interventions targeting risk factors and lifestyles is inadequate for patients and caregivers. Therefore, self-care training programs tailored according to individual severity and functional status should be developed and provided to patients and their families continuously before and after discharge.

Limitations of the Study
This study was conducted on participants who were undergoing outpatient treatment and in a relatively stable condition. Thus, the findings may not be generalizable to patients who are in the acute stage or at a high risk of recurrence. Because of the cross-sectional approach used, the causal relationship between variables could not be identified, which is another limitation. Longitudinal studies are needed to further investigate health-related outcomes, including HRQoL and the associated factors in patients who received PCI. In addition, continuous intervention studies will be necessary to monitor the causality of various factors associated with HRQoL and health-related HRQoL in patients who have received PCI.

Conclusions
In this study, age, marital status, primary caregiver, duration since first PCI, NYHA class, anxiety, and depression were shown to significantly influence HRQoL in patients who had undergone PCI procedures. These results underscore the importance of thoroughly assessing physical and psychological symptoms in patients immediately after their PCI procedure to improve their HRQoL. In particular, intervention strategies aimed at improving HRQoL in patients with severe functional limitations and in those receiving family care are necessary.
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Address correspondence to: Yujeong Kim, PhD, RN, APRN, 680, Guzkabosangro, Jung-gu, Daegu 41944, Republic of Korea.
Tel: +82-53-420-4921; E-mail: cybericu@naver.com
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