

# Health-Related Quality of Life of Coronary Artery Disease Patients under Secondary Prevention: A Cross-Sectional Survey from South India

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## ABSTRACT

**Background:** Health-related quality of life (HRQOL) is emerging as an important outcome among patients with documented coronary artery disease (CAD). The primary objective of this study was to report the HRQOL of CAD patients under secondary prevention-related treatment and follow-up using the 36-Item Short Form (SF-36) tool.

**Methods:** This was an analytical cross-sectional survey done in a hospital/clinic setting. We recruited CAD patients 30 to 80 years old with 1 to 6 years of follow-up. Patients self-reported HRQOL using SF-36.

**Results:** We recruited 1206 patients, among whom 879 (72.9%) were male. The mean age of patients was 61.3 (9.6) years. Mean ( $\pm$  standard deviation) scores for physical functioning, role limitations due to physical health, pain, and general health were  $66.48 \pm 29.41$ ,  $78.96 \pm 28.01$ ,  $80.96 \pm 21.15$ , and  $51.49 \pm 20.19$ , respectively. The scores for role limitations due to emotional problems, energy/fatigue, emotional well-being, and social functioning were  $76.62 \pm 28.0$ ,  $66.18 \pm 23.92$ ,  $76.91 \pm 20.47$ , and  $74.49 \pm 23.55$ . In subgroup analysis, age, sex, type of CAD, and treatment showed no significant association with any of the 8 domains of QOL. In addition, hypertension and diabetes showed no significant association with the individual domains of HRQOL.

**Conclusion:** Patients with coronary artery disease under secondary prevention-related treatment have suboptimal HRQOL under both physical and mental domains. The role

of demographic factors, comorbidities, disease subtypes, and treatment options in modifying HRQOL among patients with CAD appears to be minimal.

## INTRODUCTION

Noncommunicable diseases (NCDs) are known to impart a drastic and significant disease burden on low- and middle-income countries [Mahesh 2017; WHO 2017]. Among the NCDs, cardiovascular diseases (CVDs) account for the major proportion of mortality and morbidity globally [WHO 2017]. A shift of CVD burden from high-income to low- and middle-income countries (LMICs) has occurred in the last few decades [India 2017]. In India, ongoing demographic and epidemiological transitions have made this shift enormous [India 2017].

Traditionally, outcomes measured after cardiac events were predominantly classic clinical outcomes such as event-free survival and overall survival after the index event [Leidl 2001]. In the last 2 decades, there has been a radical change in quantifying medical outcomes after CVD events [Weinstein 1996]. A complementary method in terms of health-related quality of life (HRQOL) was developed to measure the medical effectiveness of interventions from the patient perspective [Weinstein 1996]. Quality of life (QOL) represents the physical and mental status of a patient related to the living context in terms of their subjective perception [Mahesh 2017]. The physical and mental QOL of cardiac patients is generally not addressed as a part of their treatment [Bahall 2018].

HRQOL in patients with heart disease can be assessed using generic or disease-specific tools. The disease-specific tools, such as the Seattle Angina Questionnaire or the Mac New, focus on heart disease-related symptoms [Spertus 1995; Hofer 2004]. The generic questionnaires, such as EQ 5D and the 36-Item Short Form (SF-36), are nonspecific from a disease perspective and enable comparison of the HRQOL

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in cardiac patients with that of the general population or patients with other illnesses [Mahesh 2017; Weinstein 1996; Lee 2018]. Among the generic tools, SF-36 is the most popular for the measurement of QOL in patients after myocardial infarction (MI) [Mahesh 2017; Weinstein 1996; Bahall 2018; Lee 2018].

Previous studies have reported low HRQOL among patients with coronary artery disease (CAD) compared with the general population [Mollon 2017; Brown 1999]. A recent study reported that MI survivors experienced significantly lower HRQOL on domains of general health, physical health, daily activity, and mental health compared with propensity score-matched controls [Brown 1999]. There is very limited information related to HRQOL among patients with CAD from South Asia.

The growing importance of HRQOL in patients with heart disease makes it necessary to identify factors associated with impaired HRQOL in this population. Identification of such predictors of low HRQOL in those with CAD may help in risk stratification, adjusting the outcomes of interventions by identifying the associated factors for different treatments, generating inputs in costing of health models, and determining patient attributes regarding health [Schweikert 2009].

The primary objective of this study was to report the HRQOL of documented CAD patients under secondary prevention-related treatment using SF-36. The secondary objective was to examine the association of factors such as age; sex; place of residence; socioeconomic status (SES); insurance coverage; risk factors such as hypertension, diabetes, and dyslipidemia; type of CAD; and type of treatment with individual domains of HRQOL.

## METHODS

The study was conducted in 2 tertiary care hospitals and 2 cardiology clinic-based practices, all situated in Ernakulam district, Kerala, India. The study was coordinated by Amrita Institute of Medical Sciences (Kochi, India). The duration of the study was 24 months (January 2017 to January 2019). The study design was an analytical cross-sectional survey.

We used the study by da Silva et al [2011] to calculate the sample size. The study reported mean  $\pm$  standard deviation (SD) of the 8 domains of SF-36. The minimum sample size required to estimate the mean for the individual domains of SF-36 with a 95% confidence interval (CI) and a precision of 2.5 units ranged from 218 to 1146. We inflated the sample size to 1200 to adjust for withdrawals from the study.

We recruited patients with documented CAD who were under secondary prevention-related treatment and follow-up at the 4 institutions included in the study. For the purpose of this study, we defined CAD as per Sheridan and Crossman [2002].

The inclusion criteria were (1) documented CAD patients with a minimum follow-up period of 1 year since diagnosis at the time of enrollment, (2) age 30 to 80 years, (3) residing in Ernakulam district, and (4) who could comprehend English or Malayalam. The exclusion criteria were (1) those with a follow-up

period of >6 years and (2) those with concomitant illnesses such as end-stage renal disease, chronic liver failure, malignancy, or stroke. We sequentially enrolled all patients from the 4 study institutions until the required sample size was achieved.

The study used a structured questionnaire to collect data regarding demographics, clinical history, type of CAD, and type of treatment. We used Kuppuswamy's socioeconomic scale (2018) for classifying the SES of the study participants [Saleem 2018]. The SES was later classified into low (<10), middle (11 to 25), and high (26 to 29) using the scores derived from the same scale [Saleem 2018]. Additional details regarding the study methodology are available in an earlier publication [Sudevan 2020].

The Medical Outcomes SF-36 questionnaire was used to collect data regarding HRQOL [Busija 2011]. The 36-item scale contains 36 questions that measure 8 domains of health status: general health, physical functioning, role limitation due to physical health (RLDPH), pain, energy/fatigue, social functioning, role limitation due to emotional health (RLDEH), and mental health [Busija 2011; Lins 2016]. The recall period of SF-36 is 4 weeks. The SF-36 tool has been validated in India by earlier studies including populations with and without disease [Sinha 2013; Manavalan 2017; Shivaprasad 2018]. The tool is used globally to measure the QOL of post-MI patients and those with other medical conditions [Eriksson 2013; Höfer 2006; Beck 2001; Simpson 2005; Pilote 2002].

The English version of SF-36 was translated to Malayalam. The Malayalam version was then back-translated to English by 2 separate language experts. The original English version and the back-translated versions were compared, and necessary modifications were done to improve concurrence. The patients were interviewed in either English or Malayalam. All interviews were done by study personnel who were trained by the principal investigator before the commencement of data collection. Administration of the SF-36 was conducted in the hospital or clinic for enrolled patients. The SF-36 tool was taken by patients at the hospital or clinic.

## Statistical Analysis

We characterized the population by computing frequencies and percentages of baseline variables. The distribution of SF-36 domains was explored by computing means and SDs, overall and by sex. We fitted separate multiple linear regression models to assess the association of each domain of SF-36 with the following risk factors: age, sex, place of residence, SES, insurance status, hypertension, diabetes, dyslipidemia, type of CAD, and treatment. We performed graphical checks to evaluate the normality assumptions required for the validity of regression models. For each risk factor in the subgroup analysis, we computed the adjusted mean difference, presented the 95% CI, and reported the statistical significance with a cutoff of 0.005 to adjust for multiple comparisons. Data were analyzed using SAS version 9.4 (SAS Institute, Cary, NC).

## Ethical Approval

The study was approved by the institutional ethics committee (IRB-AIMS-2017-125). We obtained written consent

from all study participants after informing them about the study objectives and study process. The consent form included items such as title, purpose, methods, benefits, and right to withdraw from the study. The investigators ensured strict confidentiality during the study process.

## RESULTS

### Baseline Data

We approached a total of 1230 CAD patients under secondary prevention treatment who satisfied the inclusion and exclusion criteria. Among them, 1206 (98%) provided informed consent and participated in the data collection process. All recruited patients were under follow-up after the primary event/diagnosis from the 4 study centers. The baseline details related to the study population are presented in Table 1.

In the study population, 879 (72.9%) were male, 767 (63.6%) reported to be residing in rural areas, 647 (53.6%) were 61 to 80 years old, 537 (44.5%) were 41 to 60 years old, and 22 (1.8%) were 30 to 40 years old. The mean age of males and females were  $60.4 \pm 9.6$  and  $63.5 \pm 9.3$  years respectively. The age at diagnosis of CAD or occurrence of primary event was  $58.6 \pm 9.6$  years. The median follow-up reported by the study population was 2.6 years (interquartile range 1.5, 4.4 years).

A total of 436 patients (36.2%) reported having some form of insurance coverage, and 497 (41.2%) reported having a family history of CAD. The corresponding numbers for hypertension, diabetes, and dyslipidemia were 637 (52.8%), 609 (50.5%), and 544 (45.1%). At the time of interview, 28 patients (2.3%) reported to be smokers, and 93 (7.7%) reported consumption of alcohol. Regarding diagnosis, 379 (31.4%) reported ST elevation myocardial infarction (STEMI), 285 (23.6%) reported non-ST elevation myocardial infarction (NSTEMI), 258 (21.4%) reported unstable angina, and 284 (23.5%) reported effort angina. Regarding treatment, 357 (29.7%) reported to be on medical therapy only, 679 (56.3%) reported angioplasty, and 170 (14.1%) reported coronary artery bypass graft (CABG).

### Distribution of SF-36 Domains

The SF-36 has 4 domains categorized under physical components: physical functioning, RLDPH, pain, and general health. The overall means reported were  $66.48 \pm 29.41$ ,  $78.96 \pm 28.01$ ,  $80.96 \pm 21.15$ , and  $51.49 \pm 20.19$ , respectively. The sex-stratified values for the 4 domains are presented in Table 2. The remaining 4 domains—RLDEH, energy/fatigue, emotional well-being, and social functioning—are grouped under the mental components. The corresponding means of these domains were  $76.62 \pm 28.0$ ,  $66.18 \pm 23.92$ ,  $76.91 \pm 20.47$ , and  $74.49 \pm 23.55$ . The sex-stratified values for these 4 domains are presented in Table 2.

### Subgroup Comparison of Physical Components

We did a subgroup analysis to examine the association of physical functioning, RLDPH, pain, and general health with the probable confounders listed above. Age, sex, insurance status, type of CAD, and type of treatment showed no

Table 1. Baseline characteristics of the study population\*

Variable	All	Male	Female
n	1206 (100)	879 (72.9)	327 (27.1)
Place of residence			
Urban	439 (36.4)	313 (35.6)	126 (38.5)
Rural	767 (63.6)	566 (64.4)	201 (61.5)
SES			
High	44 (3.6)	37 (4.2)	7 (2.1)
Middle	742 (61.5)	582 (66.2)	160 (48.9)
Low	420 (34.8)	260 (29.6)	160 (48.9)
Insurance			
Yes	436 (36.2)	313 (35.6)	123 (37.8)
Comorbidities			
Family history of CAD	497 (41.2)	356 (40.5)	141 (43.1)
Hypertension	637 (52.8)	427 (48.6)	210 (64.2)
Diabetes	609 (50.5)	432 (49.1)	177 (54.1)
Dyslipidemia	544 (45.1)	374 (42.6)	170 (52)
Smoking	28 (2.3)	28 (3.2)	0
Alcohol intake	93 (7.7)	84 (9.6)	9 (2.8)
CAD subtype			
STEMI	379 (31.4)	285 (32.4)	94 (28.7)
NSTEMI	285 (23.6)	210 (23.9)	75 (22.9)
Unstable angina	258 (21.4)	192 (21.8)	66 (20.2)
Effort angina	284 (23.5)	192 (21.8)	92 (28.1)
Treatment			
Medical therapy alone	357 (29.7)	211 (24.1)	146 (44.8)
Angioplasty	679 (56.3)	527 (60.1)	152 (46.6)
CABG	170 (14.1)	141 (16.0)	29 (8.9)

\*Data are n (%).

Table 2. Distribution of SF-36 domains: overall and sex-stratified profile\*

Variable	Overall	Male	Female
Physical functioning	66.48 (29.41)	68.72 (29.76)	66.48 (28.37)
RLDPH	78.96 (28.01)	81.65 (28.23)	78.96 (27.27)
RLDEP	76.62 (28.00)	78.59 (28.09)	76.62 (27.70)
Energy/fatigue	66.18 (23.92)	68.46 (24.28)	66.18 (22.79)
Emotional well-being	76.91 (20.47)	78.24 (21.02)	76.91 (18.87)
Social functioning	74.49 (23.55)	75.34 (23.34)	74.49 (24.11)
Pain	80.96 (21.15)	81.26 (21.42)	80.96 (20.42)
General health	51.49 (20.19)	50.32 (20.16)	51.49 (20.26)

\*Data are n (%).

Table 3. Subgroup comparison of physical components of SF-36\*

Subgroup	Physical Component Scoring Domain			
	Physical Functioning	RLDPH	Pain	General Health
Age category (y)				
30 to <40				
Mean difference	-5.28	-8.73	-6.73	-7.99
95% CI	-17.79, 7.35	-20.48, 3.15	-15.77, 2.42	-16.64, 0.76
Pr>  t	0.41	0.15	0.15	0.07
40 to <60				
Mean difference	-0.54	0.99	-1.42	-0.58
95% CI	-3.95, 2.91	-2.22, 4.22	-3.89, 1.07	-2.94, 1.81
Pr>  t	0.76	0.55	0.26	0.63
Female				
Mean difference	-1.49	-1.53	0.19	1.18
95% CI	-5.36, 2.42	-5.17, 2.14	-2.62, 3.02	-1.50, 3.89
Pr>  t	0.45	0.41	0.89	0.39
Rural				
Mean difference	-0.72	4.94	1.18	-0.52
95% CI	-4.16, 2.76	1.71, 8.21	-1.31, 3.69	-2.90, 1.89
Pr>  t	0.68	0.003	0.36	0.67
SES				
Low				
Mean difference	5.58	19.33	6.83	-3.23
95% CI	-3.61, 14.86	10.69, 28.05	0.18, 13.54	-9.59, 3.19
Pr>  t	0.23	<0.0001	0.04	0.32
Middle				
Mean difference	2.40	10.55	5.78	-1.32
95% CI	-6.53, 11.43	2.16, 19.04	-0.69, 12.31	-7.50, 4.93
Pr>  t	0.60	0.01	0.08	0.68
Insurance				
Mean difference	2.13	4.18	1.69	0.30
95% CI	-1.40, 5.70	0.86, 7.53	-0.87, 4.27	-2.15, 2.77
Pr>  t	0.24	0.01	0.19	0.81
Risk factor				
Hypertension				
Mean difference	-0.97	-0.08	0.06	0.99
95% CI	-4.55, 2.66	-3.45, 3.32	-2.53, 2.68	-1.50, 3.49
Pr>  t	0.60	0.96	0.96	0.43
Diabetes				
Mean difference	-1.06	-0.29	-1.05	-0.79
95% CI	-4.40, 2.33	-3.44, 2.89	-3.48, 1.39	-3.11, 1.55
Pr>  t	0.54	0.85	0.39	0.50
Dyslipidemia				

Mean difference	-7.2	-3.62	-4.20	-3.45
95% CI	-10.83, -3.53	-7.03, -0.17	-6.83, -1.55	-5.97, -0.91
Pr>  t	0.0001	0.04	0.0018	0.007
CAD type				
Effort angina				
Mean difference	1.92	3.60	-1.81	-0.79
95% CI	-3.09, 6.99	-1.11, 8.36	-5.44, 1.85	-4.25, 2.72
Pr>  t	0.45	0.13	0.33	0.66
NSTEMI				
Mean difference	2.66	0.80	-0.45	0.75
95% CI	-2.30, 7.67	-3.86, 5.50	-4.04, 3.17	-2.68, 4.22
Pr>  t	0.29	0.74	0.80	0.66
STEMI				
Mean difference	3.71	2.48	0.18	0.57
95% CI	-0.95, 8.42	-1.90, 6.91	-3.19, 3.59	-2.66, 3.83
Pr>  t	0.12	0.23	0.91	0.73
Treatment				
Angioplasty				
Mean difference	1.07	0.74	1.94	1.35
95% CI	-2.79, 4.97	-2.89, 4.40	-0.86, 4.76	-1.32, 4.05
Pr>  t	0.59	0.69	0.17	0.32
CABG				
Mean difference	-2.53	0.50	-0.21	1.09
95% CI	-8.04, 3.03	-4.68, 5.72	-4.20, 3.81	-2.72, 4.94
Pr>  t	0.37	0.85	0.92	0.58

\*Mean difference adjusted for multiple comparisons.

Pr indicates probability.

significant association with any of the 4 physical domains of QOL. In addition, hypertension and diabetes showed no significant association with the physical domains.

The RLDPH domain showed significant associations with place of residence and SES. Compared with patients from urban areas, those from rural areas showed higher values for RLDPH (adjusted mean difference 4.94;  $P = .003$ ). Patients from the low SES group showed higher values for RLDPH compared with the high SES group (adjusted mean difference 19.33;  $P < .0001$ ).

Both physical functioning and pain showed an association with dyslipidemia. Those without dyslipidemia reported lower physical functioning (adjusted mean difference -7.2;  $P = .0001$ ) versus those with dyslipidemia. Similarly, those without dyslipidemia reported lower pain (adjusted mean difference -4.20;  $P = .0018$ ) versus those with dyslipidemia. The details of subgroup comparison of physical components are presented in Table 3.

### Subgroup Comparison of Mental Components

We examined the association of mental component domains with age, sex, place of residence, SES, insurance, risk

factors, type of CAD, and type of treatment. Age, sex, type of CAD, and type of treatment showed no significant association with any of the 4 mental domains of QOL. In addition, hypertension and diabetes showed no significant association with the mental domains.

The domain role RLDEP showed a significant association with SES and insurance. Compared with the high SES group, the low SES group showed a higher value for RLDEP (adjusted mean difference 14.62;  $P = .001$ ). Similarly, those with insurance reported higher values for RLDEP compared with those who reported no insurance (adjusted mean difference 5.24;  $P = .002$ ). The social functioning domain showed a significant association with dyslipidemia. Those without dyslipidemia reported lower social functioning versus those with dyslipidemia (adjusted mean difference -6.01;  $P < .0001$ ). The subgroup comparison of mental components is represented in Table 4.

## DISCUSSION

This is the first large study from South Asia that looked at HRQOL of patients with documented CAD who were under

Table 4. Subgroup comparison of mental components of SF-36\*

Subgroup	Mental Component Scoring Domain			
	RLDEP	Energy/Fatigue	Emotional Well-Being	Social Functioning
Age category (y)				
30 to <40				
Mean difference	−0.83	−3.41	−3.46	−8.42
95% CI	−12.64, 11.11	−13.66, 6.95	−12.28, 5.46	−18.45, 1.70
Pr>  t	0.89	0.51	0.44	0.09
40 to <60				
Mean difference	1.79	0.05	−0.84	−1.94
95% CI	−1.43, 5.05	−2.75, 2.87	−3.24, 1.59	−4.68, 0.82
Pr>  t	0.27	0.97	0.49	0.16
Female				
Mean difference	−0.65	−2.26	−1.54	−0.05
95% CI	−4.31, 3.05	−5.43, 0.95	−4.27, 1.22	−3.15, 3.09
Pr>  t	0.73	0.16	0.27	0.97
Rural				
Mean difference	4.28	0.31	0.17	−0.87
95% CI	1.03, 7.56	−2.51, 3.16	−2.26, 2.62	−3.62, 1.92
Pr>  t	0.009	0.83	0.89	0.53
SES				
Low				
Mean difference	14.62	8.75	−0.09	−1.38
95% CI	5.94, 23.38	1.22, 16.36	−6.57, 6.46	−8.74, 6.06
Pr>  t	0.001	0.02	0.98	0.71
Middle				
Mean difference	7.76	4.82	−0.98	−0.16
95% CI	−0.68, 16.28	−2.51, 12.22	−7.28, 5.39	−7.32, 7.08
Pr>  t	0.07	0.19	0.76	0.97
Insurance				
Mean difference	5.24	−0.02	0.61	2.19
95% CI	1.90, 8.61	−2.92, 2.90	−1.88, 3.13	−0.64, 5.05
Pr>  t	0.002	0.99	0.63	0.13
Risk factor				
Hypertension				
Mean difference	−1.84	0.27	−0.12	−0.76
95% CI	−5.23, 1.58	−2.67, 3.24	−2.65, 2.43	−3.63, 2.14
Pr>  t	0.29	0.86	0.92	0.60
Diabetes				
Mean difference	−1.40	−0.23	−0.08	0.35
95% CI	−4.57, 1.79	−2.98, 2.54	−2.45, 2.30	−2.34, 3.06
Pr>  t	0.38	0.87	0.94	0.80
Dyslipidemia				



Mean difference	−3.36	−2.59	−1.77	−6.01
95% CI	−6.79, 0.11	−5.57, 0.42	−4.33, 0.82	−8.92, −3.07
Pr>  t	0.05	0.09	0.18	<0.0001
Type of CAD				
Effort angina				
Mean difference	3.02	−1.49	1.38	2.32
95% CI	−1.71, 7.81	−5.60, 2.66	−2.15, 4.95	−1.70, 6.37
Pr>  t	0.21	0.48	0.44	0.26
NSTEMI				
Mean difference	1.27	1.37	1.99	3.48
95% CI	−3.41, 6.00	−2.70, 5.47	−1.51, 5.52	−0.49, 7.49
Pr>  t	0.59	0.51	0.26	0.09
STEMI				
Mean difference	0.48	−0.47	1.49	2.51
95% CI	−3.92, 4.93	−4.29, 3.39	−1.79, 4.82	−1.23, 6.28
Pr>  t	0.83	0.81	0.37	0.19
Treatment				
Angioplasty				
Mean difference	0.86	0.51	0.81	−1.28
95% CI	−2.78, 4.54	−2.66, 3.70	−1.91, 3.56	−4.38, 1.84
Pr>  t	0.64	0.75	0.56	0.42
CABG				
Mean difference	−0.74	−0.79	0.30	−3.43
95% CI	−5.94, 4.52	−5.30, 3.77	−3.59, 4.22	−7.84, 1.03
Pr>  t	0.78	0.73	0.88	0.13

\*Mean difference adjusted for multiple comparisons.

Pr indicates probability.

secondary prevention-related treatment and follow-up. The current study is probably the first that covered all major subtypes of CAD patients. The sample also represents patients under medical management, angioplasty, and CABG. Among the individual HRQOL domains, the maximum value was seen for pain and the minimum for general health.

In the subgroup analysis, 6 variables—age, sex, hypertension, diabetes, type of CAD, and type of treatment—showed no association with any of the 8 domains of SF-36. Among the subgroup variables, dyslipidemia showed the maximum association and was associated with 3 domains: physical functioning, pain, and social functioning. SES showed an association with 2 domains: RLDPH and RLDEP. The place of domicile and insurance status showed an association with 1 domain each, RLDPH and RLDEP, respectively.

A comparison between the current study results and that of a small study from India among community-dwelling disease-free individuals suggests that the predominant deficiencies come under the domains of physical functioning (93.59 versus 66.48), general health (79.41 versus 51.49), social functioning (90.42 versus 74.4), and emotional well-being (86.16 versus 76.91) [Sinha 2013].

HRQOL in CAD is probably influenced by several factors. Norris et al [2010] reported that age, sex, physical limitation, coronary anatomy, ejection fraction, and angina frequency together accounted for more than half of the variations in HRQOL among patients with CAD. In the current study, demographic factors such as age and sex did not show an independent role in modifying the HRQOL of CAD patients. The Pro-active Heart Trial examined the HRQOL among survivors of MI at 6 months' follow-up and reported a mixed association [Hawkes 2013]. Older CAD patients (>60 years) reported lower physical HRQOL (−4.9, 95% CI −7.6, −2.2) and higher mental HRQOL (2.8, 95% CI 0.7, 4.9) compared with their younger counterparts [Hawkes 2013]. Schweikert et al [2009] reported that HRQOL differences between CAD patients and the general population was highest in the lower age groups. In the highest age group, there was no significant difference in HRQOL between CAD patients and their general counterparts [da Silva 2011]. The differences in study populations, tools, and analytical approaches may be the reasons for the different associations reported by the 3 studies.

The evidence related to the association of sex with HRQOL among patients with CAD gives mixed signals. Several studies

have reported lower HRQOL values for women with CAD compared with their male counterparts [Schweikert 2009; Norris 2010; Martin 2012; Gijsberts 2015]. Martin et al [2012] reported lower HRQOL values for women with a history of CABG compared with men. The sex-based differences for individual domains were smaller and within a range of 2.03 to 3.71 units. The lack of sex-based difference in the current study, in contrast with Martin et al [2012], could be due to longer duration of follow-up (6 months versus 2 years) and the inclusion of all types of CAD.

The MONICA/KORA registry reported an adjusted HRQOL deficiency of 3.29 units for women MI survivors compared with their male counterparts as assessed by the EQ VAS at a mean follow-up of 9 years [Schweikert 2009]. The sex-based difference was predominantly contributed by patients in the older age strata (>65 years) [Schweikert 2009]. The German cohort [Schweikert 2009] is older, with a mean age of  $68.0 \pm 9.6$  years, than that of the current study (mean age of  $61.3 \pm 9.6$  years).

Among the sociodemographic factors, only SES showed an association with HRQOL among CAD patients. This association was seen for 2 domains: RLDPH and RLDEP. Surprisingly, CAD patients hailing from the low socioeconomic levels exhibited significantly higher values for both domains in comparison with those from high SES levels.

In this study, both diabetes and hypertension failed to show an independent role in modifying the HRQOL of CAD patients. The lack of any significant association in the adjusted analysis was seen for all 8 domains of SF-36. Dyslipidemia was the only risk factor that showed an association with HRQOL: patients with dyslipidemia had a significant positive association with 3 of the 8 domains of SF-36.

Several studies have examined the association between diabetic status and HRQOL among patients with CAD under treatment and follow-up [Schweikert 2009; Martin 2012; Lindsay 2000]. Martin et al [2012] reported significant deficiencies for 4 of 8 HRQOL domains among CAD patients with diabetes who underwent CABG compared with their nondiabetic counterparts. The deficiencies at a follow-up of 6 months were small and ranged from -1.91 to -3.20 units [Martin 2012]. In contrast, Rumsfeld et al [2003] reported no association between diabetic status and HRQOL separately for patients with medically refractive angina who underwent either percutaneous coronary intervention (PCI) or CABG. The differences in study sample selection, duration of follow-up, and analytical approach may be reasons for the different results seen in the 3 studies.

The current study reported higher HRQOL among those CAD patients who were insured compared with their non-insured counterparts. This association was weak and was restricted to only 1 domain of SF-36 (RLDEP).

The association between HRQOL and type of treatment for CAD was examined by several studies in the past [Spertus 1995; Rumsfeld 2003; van Domburg 2008; Zhang 2003; Spertus 2005; Cohen 2011; Weintraub 2008]. Domburg et al [2008] reported that among CAD patients who were assessed at 36 months' follow-up, there was no significant differences in HRQOL between PCI and CABG arms. Rumsfeld et al [2003]

reported that in patients with medically refractive angina, none of the HRQOL domains showed significant differences between CABG and PCI arms when assessed at 6 months' follow-up. Similarly, Zhang et al [2003] reported that QOL was comparable between those treated with PCI versus those with CABG at 12 months' follow up. Results from the current study as well as the majority of those reported above suggest a lack of association between HRQOL and type of treatment in CAD patients.

### Strengths and Limitations

The strengths of this study are a large sample size, availability of sociodemographic data, inclusion of all major categories of CAD, information on various types of treatment, and adjusted analysis to minimize confounding. The limitations include lack of geographic/ethnic variability and non-availability of details related to depression.

### Conclusion

Coronary artery disease patients under secondary prevention-related treatment have suboptimal HRQOL under both physical and mental domains. Comparison with earlier studies suggests marked heterogeneity and limited roles for factors such as age, sex, diabetes, hypertension, and type of treatment in modifying the HRQOL among patients with CAD under treatment. This also suggests that the major drivers of HRQOL among patients with CAD under treatment are yet to be identified. Future studies should focus on identifying such factors. Treatment protocols as well as interventions targeting improvements in outcomes for CAD patients should consider documentation and regular monitoring of HRQOL.

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