Awareness of cardiovascular disease among Korean women: Results from a nationwide survey

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ABSTRACT

Women underestimate the risk of cardiovascular disease (CVD). It is essential to assess and raise awareness regarding CVD among women to reduce disease burden and mortality. Therefore, we investigated the awareness regarding CVD among Korean women. We conducted a nationwide survey between December 2020 and January 2021 among a representative sample of Korean women using random-digit-dialing telephonic interviews. We sought information regarding the awareness of CVD risk; recognition of symptoms and signs; and knowledge of the cause and prevention of and appropriate response to CVD. A total of 1,050 women (mean age, 60.2 ± 11.9 years) participated in the study. Approximately 52.0% of participants were unaware of CVD, and only 26% of participants had heard of CVD. Participants considered that compared to other diseases, CVD was not an important health issue for women, and few of them thought that cerebrovascular diseases and CVD were the leading causes of death (10.9% and 7.6%, respectively). After adjustment for possible confounding factors, age >70 years, rural residence, and educational attainment below college were independently associated with a lack of awareness regarding CVD. The awareness regarding CVD being the leading cause of death in women is low, and most women do not consider it an important health issue. Therefore, special attention must be paid to educate the public regarding CVD in women.

1. Introduction

Among single-organ diseases, cardiovascular disease (CVD) is the leading cause of death in Korean women. (Statics Korea, 2019; Vital Statistics Division et al., 2020) The death rate due to cardiovascular and cerebral diseases was 1.1 times higher in women than in men in 2019 (122.7/112.0 per 100,000 population). However, women tend to underestimate the risk of CVD and perceive CVD as a major concern for only men.

Low awareness of CVD among women was reported by the American Heart Association (AHA) in 1997, and it was correlated with insufficient actions by women to lower their CVD risk. (Mosca et al., 2000; Mosca et al., 2006) With dedicated education and promotion through the "Go Red for Women" campaign by the AHA, awareness of CVD among American women increased between 1997 and 2012, but it declined again between 2009 and 2019, which demonstrates a need for continued efforts to educate women. (Cushman et al., 2021)

Meanwhile, awareness and knowledge of CVD among Korean women

have not been established. We evaluated the current status of awareness and perception of CVD in women among the general Korean female population through a contemporary population-based survey. The purpose of this survey was to provide the basic data necessary for setting targets for prevention of CVD in women and promotion of education regarding the same.

2. Methods

2.1. Study design and data collection

This cross-sectional telephonic survey was conducted between December 2020 and January 2021. The survey process, except for the study design, was outsourced to a research company (Megaresearch, Seoul, Korea). The estimated target population (aged $\geq$ 40 years) in November 2020 was 14,035,414. To represent Korean adults aged $\geq$ 40 years, the survey population (n = 1050) was selected using a stratified systematic sampling method considering age (40–49 years, 50–59 years, 60–59 years, and $\geq$ 70 years) and place of residence (seven metropolitan cities and seven non-metropolitan cities). In conducting the telephonic interviews, computer-generated random digit dialing (RDD) was used so that an equal number of households in each area were contacted. Due to an increase in the number of households without landline telephones, which use mobile phones preferentially, the number of non-landline telephone numbers could be excluded from the survey only by landline telephone surveys through proportional allocation extraction. Therefore, 20% of the total survey sample was selected using mobile phone RDD. (Lee et al., 2010) The structured interviews were performed by 20 well-trained surveyors with an average survey experience of 10 years. During the telephonic survey, each surveyor was monitored in real time. Five percent of all survey files were verified, and if the surveyors could not deliver the appropriate content, or if there were problems such as an inappropriate answer from a respondent, the data were discarded, surveyors were retrained and a new investigation was performed.

2.2. Study population

The study population was extracted from the estimated target population residing across the country by stratification according to age and place of residence. Eligible participants were women aged $\geq$ 40 years who agreed to participation in the survey and answered the questions after understanding them. Responses that were complete up to the last question were considered as valid responses. We excluded the following participants: (1) those aged <40 years, (2) those whose comprehension was significantly lower than that required to understand the words used in the survey, and (3) those who did not agree to participate in the survey.

2.3. Questionnaire

A draft questionnaire was developed by the committee of the Women's Heart Disease Research Working Group. The questionnaire items were carefully selected by reviewing and modifying previous surveys (Cushman et al., 2021; Jung et al., 2019) and adding new questions that reflected female-specific trait factors. Questions about age, gender, and place of residence preceded the survey to determine the eligibility of a participant. The main survey was divided into three parts. The first section, demographic data including educational attainment, income, presence of hypertension, dyslipidemia, diabetes, and CVD, alcohol consumption status, smoking status, and employment were evaluated by participants' response to questions asked by well-trained surveyors. The second section assessed awareness of women's health issues and CVD. The question about the awareness of CVD in women was "How much do you think you know about women's heart disease?" and there were four answers: 1) I know very well, 2) I know well, 3) Usually I

know, and 4) I do not know. The answers were based on the subjective judgment of the participants. The last section investigated the degree of knowledge about CVD in women (symptoms, cause, appropriate response, and prevention). The questions of the last section were to test participants' knowledge about CVD. High awareness group defined as who answered that they know about CVD in women very well or well, and low awareness group as who answered that they usually know about CDV in women or they don't know. (Supplementary Table S1, Question No.7)

2.4. Ethics

Personal information was not collected during the telephonic interviews, and the local institutional review board of Seoul National University Boramae Medical Center approved this study and waived written informed consent.

2.5. Statistical analysis

All categorical data are presented as frequencies and percentages. A Pearson chi-square test was used to compare categorical variables. A linear-by-linear association was used to extract trends of clinical characteristics according to the responses. In addition, a univariate analysis and subsequent multivariate logistic regression analysis were performed to assess the risk of lack of awareness about CVD in women after adjusting for individual risk factors. Variables with predictive significance ($p < 0.05$) in the univariate analysis were included in the regression analysis. Statistical significance was set at $p < 0.05$. All analyses were performed using SPSS software (version 22.0; IBM Corp., Armonk, NY, USA).

3. Results

3.1. Characteristics of the study population

A total of 1050 participants completed the RDD telephonic interview after selection based on systematic stratification sampling. The study participants were evenly distributed according to age and place of residence. The mean age of the study population was 60.2 ± 11.9 years (range, 40–92 years), and 46.7% of participants were college graduates. Table 1 presents the characteristics of the study population. Among all participants, the most common risk factor for CVD was hypertension (24.3%), followed by dyslipidemia (18.1%), and diabetes (9.2%); CVD and cerebrovascular disease were present in 2.9% and 1.6% of participants, respectively. Only 3.0% of participants were current smokers, and 32.4% of participants were social alcohol drinkers. Half of the participants (51.9%) were housewives, and 34.3% were office workers.

### 3.2. Awareness regarding women's health issues and CVD

Awareness regarding CVD in women: Approximately half (52.0%) of the participants did not know about CVD in women (Fig. 1). Participants' awareness regarding CVD in women was significantly different according to demographic factors, including age, urbanization level of the area of residence, educational attainment, and household income (Table 2). Compared to women in other age groups, those aged between 60 and 69 years had the highest rates of awareness (percentage of those who answered "I know very well," "I know well," and "usually I know"). Participants living in urban areas had significantly higher awareness than did those living in rural areas. In addition, the awareness increased with an increase in the level of education. Higher household income was also associated with a higher awareness of CVD in women. However, there was no difference in awareness according to the presence of comorbidities.

Source of information about CVD in women: Two-thirds (62.8%) of the participants answered that they did not receive sufficient

Table 1
Characteristics of the study population.

Characteristics	Total n = 1050
Age, years (mean ± SD)	60.2 ± 11.9
Urbanization level of residence, n (%)	
Urban (dong)	889 (84.7)
Rural (eup, myeon)	161 (15.3)
Education attainment, n (%)	
Middle school or less	249 (23.7)
High school	311 (29.6)
College or more	490 (46.7)
Household income (HI, KRW 1000/month), n (%)	
HI ≤ 1000	178 (17.0)
1000 < HI ≤ 2000	116 (11.0)
2000 < HI ≤ 3000	158 (15.0)
3000 < HI ≤ 4000	131 (12.5)
4000 < HI ≤ 5000	129 (12.3)
HI > 5000	338 (32.2)
Risk factors of CVD, n (%)	
Hypertension	255 (24.3)
Dyslipidemia	190 (18.1)
Diabetes	97 (9.2)
Cardiovascular disease	30 (2.9)
Cerebrovascular disease	17 (1.6)
Current smoker	31 (3.0)
Socially alcohol drinker	340 (32.4)
Job, n (%)	
House-wife	545 (51.9)
Office worker	360 (34.3)
Blue-collar worker	90 (8.6)
Others	55 (5.2)
Alcohol consumption, n (%)	
Never	710 (67.6)
Social drinker	340 (32.4)
Smoking status, n (%)	
Never	1012 (96.4)
Ex-smoker	7 (0.7)
Current-smoker	31 (3.0)

CVD, cardiovascular disease; KRW, Korean Won; SD, standard deviation.
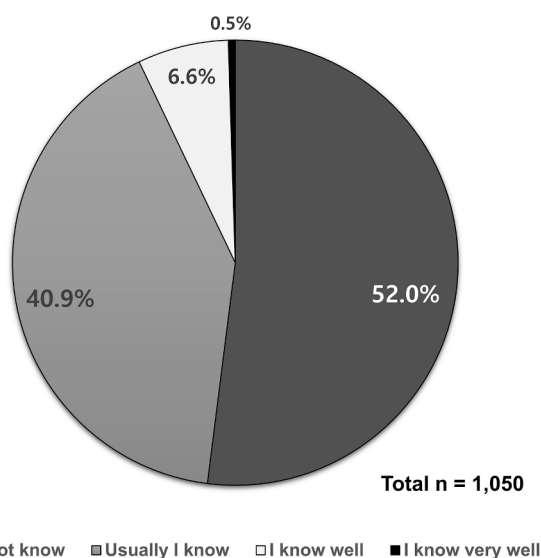
Fig. 1. The extent to which women know about cardiovascular disease. Question) How much do you think you know about women's heart disease?

information about CVD. Only 26% of participants had heard of CVD in women in the previous year (Fig. 2). The most common sources of information were television and radio (61.5%); other sources included friends, relatives, hospital staff, internet, and YouTube.

Table 2
Awareness of cardiovascular disease in women.

Characteristics	Answer				p-value
	I know very well	I know well	Usually I know	I do not know	
Total population, n (%)	5 (0.5)	69 (6.6)	429 (40.9)	547 (52.0)	
Age (years), n (%)					< 0.001*
40–49 (n = 269)	2 (40.0)	14 (20.3)	109 (25.4)	144 (26.3)	
50–59 (n = 269)	1 (20.0)	28 (40.6)	117 (27.3)	123 (22.5)	
60–69 (n = 252)	2 (40.0)	17 (24.6)	134 (31.2)	99 (18.1)	
≥70 (n = 260)	0 (0.0)	10 (14.5)	69 (16.1)	181 (33.1)	
Urbanization level of residence, n (%)					0.004*
Urban (dong) (n = 889)	5 (100.0)	65 (94.2)	375 (87.4)	444 (81.2)	
Rural (eup, myeon) (n = 161)	0 (0.0)	4 (5.8)	54 (12.6)	103 (18.8)	
Education attainment, n (%)					< 0.001*
Middle school or less (n = 249)	0 (0.0)	6 (8.7)	61 (14.2)	182 (33.3)	
High school (n = 311)	2 (40.0)	22 (31.9)	130 (30.3)	157 (28.7)	
College or more (n = 490)	3 (60.0)	41 (59.4)	238 (55.5)	208 (38.0)	
Household income (HI, 1000 KRW/month), n (%)					<0.001*
HI ≤ 1,000 (n = 178)	0 (0.0)	6 (8.7)	41 (9.5)	131 (23.9)	
1000 < HI ≤ 2000 (n = 116)	0 (0.0)	4 (5.8)	42 (9.8)	70 (12.8)	
2000 < HI ≤ 3000 (n = 158)	1 (20.0)	11 (15.9)	75 (17.5)	71 (13.0)	
3000 < HI ≤ 4000 (n = 131)	0 (0.0)	8 (11.6)	67 (15.6)	56 (10.2)	
4000 < HI ≤ 5000 (n = 129)	2 (40.0)	8 (11.6)	63 (14.7)	56 (10.2)	
HI > 5000 (n = 338)	2 (40.0)	32 (46.4)	141 (32.9)	163 (29.8)	
Presence of comorbidity[†], n (%)					0.231
Yes (n = 384)	2 (40.0)	33 (47.8)	157 (36.6)	192 (35.1)	
No (n = 666)	3 (60.0)	36 (52.2)	272 (63.4)	355 (64.9)	

χ2-test for each group (*p-value < 0.05). [†] presence of hypertension, dyslipidemia, diabetes, cardiovascular disease, or cerebrovascular disease.
KRW, Korean Won.

Importance of women's health issues and specific factors: The majority of participants believed that cancer was the leading cause of death in women (60.6%, Supplementary Fig. S1). Few participants thought that cerebrovascular disease and CVD were the leading causes of death (only 10.9% and 7.6%, respectively). Participants believed that the biggest health problems in women were stress (19.2%), osteoporosis (18.5%), and dementia (18.3%), rather than CVD (8.6%) (Supplementary Fig. S2). Regarding the relationship between CVD and menopause and pregnancy, which are women-specific risk factors of CVD, more than half of the participants (59.7%) thought that the incidence of CVD increased after menopause, and 52.2% of participants did not think that there was a relationship between the number of pregnancies and CVD. Moreover, compared to younger women, those >60 years of age were significantly more likely to agree that CVD is more dangerous in women than in men (Fig. 3).
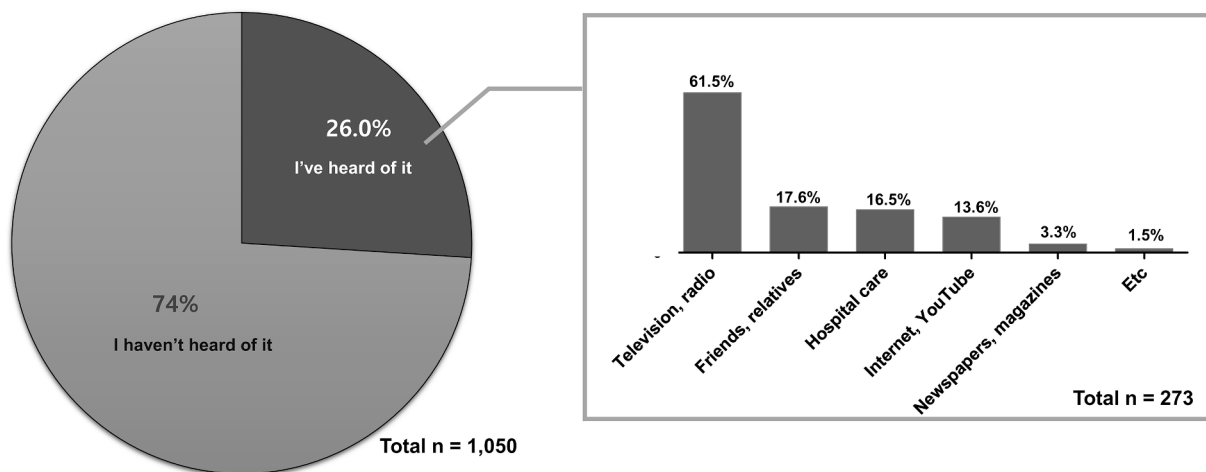
Fig. 2. Awareness of cardiovascular disease in women and the awareness pathways. Question) Have you ever heard of a woman with heart disease in the last year?
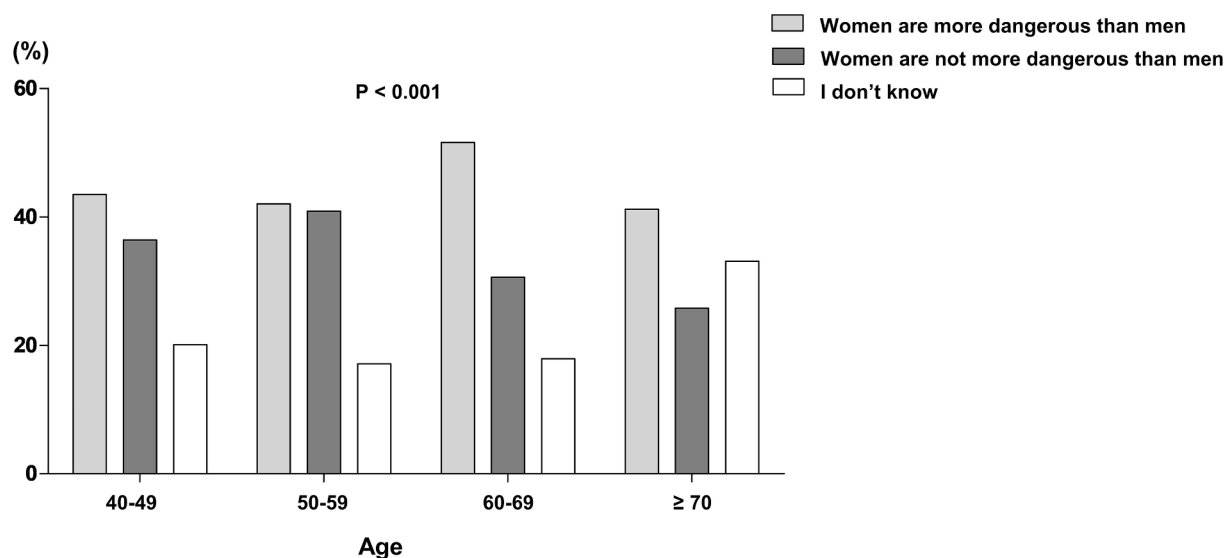

Fig. 3. Awareness of the risk of cardiovascular disease in women. Question) Do you agree that "heart disease is more dangerous in women than in men "?
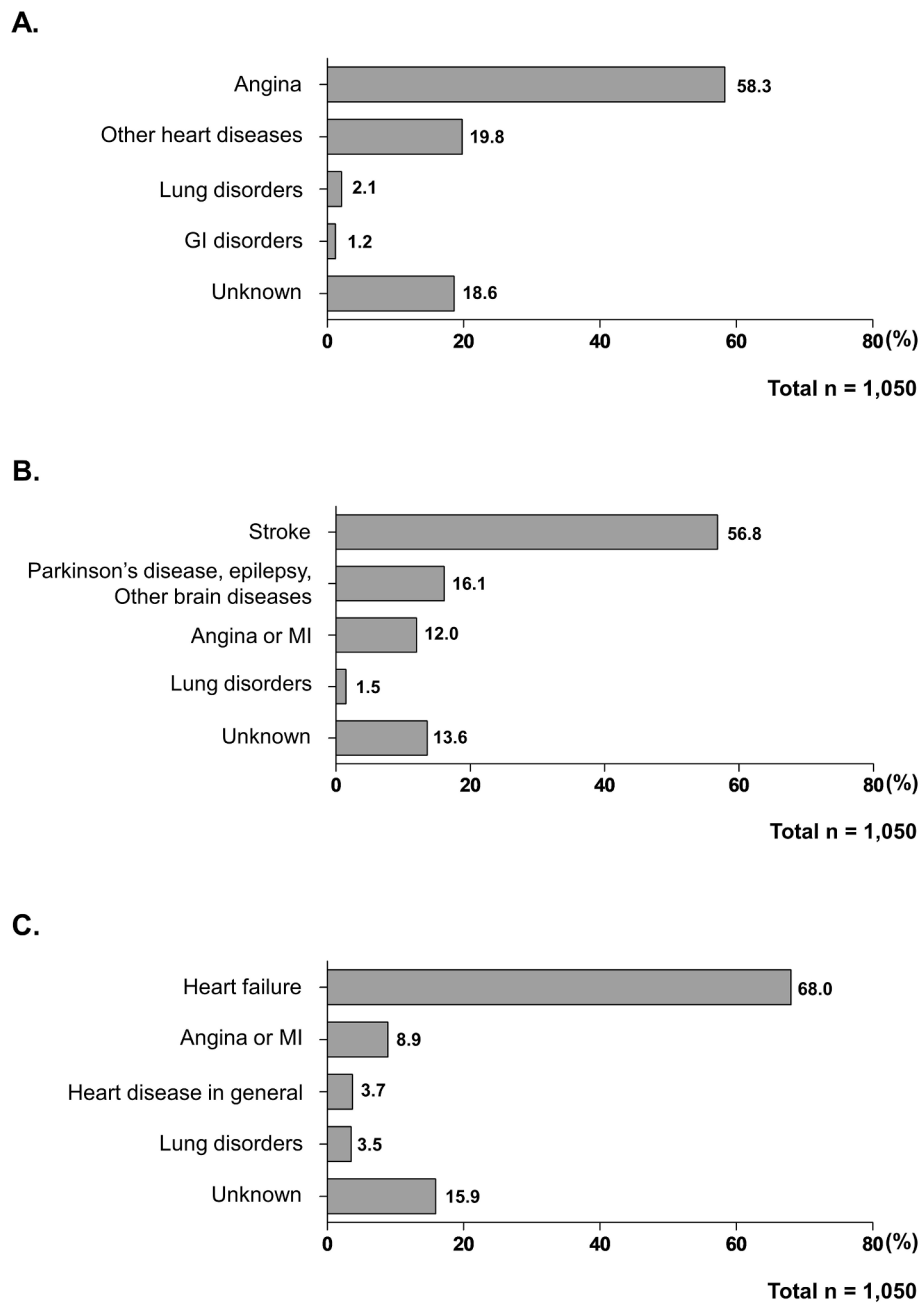
3.3. Degree of knowledge about CVD in women

Recognition of symptoms of CVD: The degree of knowledge about the symptoms of CVD was high in the study population (Fig. 4). More than half of the participants (58.3%) recognized the characteristic chest pain of angina as angina (Fig. 4A), and most participants (83.4%) acknowledged that chest pain was a symptom of suspected angina (Supplementary Fig. S3). In addition, more than half of the participants (56.8%) identified the characteristic paralysis observed in patients with stroke as a stroke (Fig. 4B), and two-thirds of the participants (68.0%) recognized symptoms such as shortness of breath and swelling as hallmarks of heart failure (Fig. 4C). The high awareness group correctly recognized chest pain as angina and paralysis as a stroke; therefore, the degree of knowledge was significantly higher than that of the low awareness group (77.0% vs. 56.9%, p < 0.001 and 78.4% vs. 55.1%, p = 0.003, respectively) (Table 3).

The cause and prevention of and appropriate response to CVD: Participants chose lack of exercise, dyslipidemia, and hypertension as the most important causes of CVD. In addition, family history of CVD, diabetes, and smoking were considered causes of CVD (Fig. 5). Only half of the participants were aware of the appropriate response to signs of a heart attack (Supplementary Fig. S4). Of all participants, 49.6%

preferred calling 119 which means direct contact to emergency services, and only 33% of the participants preferred going to the hospital. Most participants (90.5%) believed that regular exercise was the most important behavior for the prevention of CVD, and recognized that avoiding stress, not eating salty food, controlling weight, reducing fat intake, and not smoking prevent CVD (Supplementary Fig. S5).

3.4. Risk factors for lack of awareness of CVD in women

The univariate analysis showed that the following variables were associated with a lack of awareness about CVD in women (the answer "I do not know about CVD in women"): age >70 years, rural residence, educational attainment below college, and low household income. After adjustment for possible confounding factors, age >70 years was associated with a 1.70-fold increased hazard for lack of awareness about CVD in women in the multivariate logistic regression analysis (Table 4). Rural residence and educational attainment below college were also independently associated with a lack of awareness. Low household income (<2000, 1000 Korean Won/month) was associated a tendency toward lower awareness, although not statistically significant.

A.

Angina — 58.3
Other heart diseases — 19.8
Lung disorders — 2.1
GI disorders — 1.2
Unknown — 18.6

0   20   40   60   80 (%)

Total n = 1,050

B.

Stroke — 56.8
Parkinson's disease, epilepsy, Other brain diseases — 16.1
Angina or MI — 12.0
Lung disorders — 1.5
Unknown — 13.6

0   20   40   60   80 (%)

Total n = 1,050

C.

Heart failure — 68.0
Angina or MI — 8.9
Heart disease in general — 3.7
Lung disorders — 3.5
Unknown — 15.9

0   20   40   60   80 (%)

Total n = 1,050

Fig. 4. Recognition of the symptoms of cardiovascular disease. (A) What do you think is indicated by a stiff chest pain that worsens when active and disappears when resting?. (B) What do you think is indicated by facial paralysis, double image of an object, and sudden paralysis of one arm?. (C) What do you think is the reason someone is easily out of breath and tired, even with little activity, or has swollen ankles?

4. Discussion

In this survey on public awareness and knowledge CVD in Korean women, we found that half of the participants lacked awareness regarding CVD in women and few had heard of it. Compared to other diseases, they did not consider CVD as an important health issue for women. In particular, only 7.6% of participants recognized CVD as the leading cause of death. In addition, more than half of the participants did not know how to appropriately cope with an emergency situation such as a heart attack. However, the degree of knowledge about the typical symptoms of CVD in women was high. Participants valued behavioral factors such as exercise, rather than disease, as a cause of CVD, and most participants believed that regular exercise can prevent CVD. Old age, rural residence, and low educational attainment were independently associated with a lack of awareness of CVD in women.

CVD is one of the leading cause of death among Korean women. According to the subject-specific data of the Korea Statistical Information Service (KOSIS, https://www.kosis.kr), malignant neoplasms are ranked as the leading cause of death in Korean women, and circulatory system disease is ranked second. (Statics Korea, 2019) In the United States (US), CVD has surpassed malignant neoplasm as the leading cause of death in women since 2018,(Cushman et al., 2021) and Korean women are expected to follow the trend of cause of death seen among US women due to increasing acceptance of western lifestyles and behaviors. Despite these trends, CVD was not considered a serious cause of death in our study. Only 7.6% of participants considered CVD as one of the most important causes of death. Thus, the awareness that CVD can cause death was low. This percentage was markedly lower than that in other

Table 3

Difference in knowledge about cardiovascular disease in women according to awareness.

	High awareness group (n = 74)	Low awareness group (n = 976)	*p*-value
Recognition of cardiovascular disease with chest pain, n (%)			<0.001*
Angina	57 (77.0)	555 (56.9)	
Other heart diseases	16 (21.6)	192 (19.7)	
Lung disorders	0 (0.0)	22 (2.3)	
GI disorders	1 (1.4)	12 (1.2)	
Unknown	0 (0.0)	195 (20.0)	
Recognition of cardiovascular disease with paralysis, n (%)			0.003*
Stroke	58 (78.4)	538 (55.1)	
Parkinson's disease, epilepsy, other brain diseases	5 (6.8)	164 (16.8)	
Angina or MI	6 (8.1)	120 (12.3)	
Lung disorders	0 (0.0)	16 (1.6)	
Unknown	5 (6.8)	138 (14.1)	

χ2-test for high awareness vs. low awareness (*$p < 0.05$). GI, gastrointestinal; MI, myocardial infarction.

High awareness group: I know very well + I know well; Low awareness group: I do not know + usually I know.

countries. In a national survey by the AHA in 2019, 44% of women were aware of CVD as the leading cause of death in women, although it declined from 65% of women being aware in 2009,(Cushman et al., 2021) results differed according to ethnicity, household income, educational attainment, and previous medical history. In recent surveys, women's awareness of CVD as the leading cause of death was 14.4% in Chile, 9% in Singapore, and 4% in the United Arab Emirates. (Singapore Heart Foundation, 2020; Khan and Ali, 2017; Varleta et al., 2020) It is necessary to publicize and raise awareness that CVD will become the leading cause of death in women.

Majority of Korean women were unaware that CVD can lead to death, and more than half of the participants in this study did not know about CVD in women. Awareness of CVD among women aged >70 years old was clearly low; however, at least 50% of participants in their 40 s, 50 s, and 60 s knew about CVD in women. In particular, those >70 years of age had a 1.70-fold increased risk of a lack of awareness of CVD in our study compared to their counterparts. A similar finding was found in a heart failure awareness study conducted recently in Korea (total participants, 1032; women 49.4%); the awareness of heart failure among

participants >67 years of age was significantly lower than that among those <67 years of age, and those ≥ 67 years old had a 1.6-fold higher risk of a low awareness of heart failure than did their counterparts. (Kim et al., 2020) In this heart failure awareness study, low levels of education and household income were independently associated with a low awareness of heart failure. Socioeconomic status has a significant impact on cardiovascular health and is a measurable factor. (Schultz et al., 2018) Individuals with low socioeconomic status are likely to have a significant burden of CVD and poor outcomes. (Mosquera et al., 2016; Rosengren et al., 2019) Indeed, the low awareness of CVD in individuals with low socioeconomic status may be a significant risk factor for CVD. The results from the 2019 AHA National Survey on women's awareness of coronary heart disease also showed that the awareness about CVD in women was directly proportional to the level of education. (Cushman et al., 2021) These findings are consistent with our results that women's awareness may have been affected by disparities in wealth and education that can ultimately affect overall and cardiac health. In particular, low socioeconomic status, including rural residence and low educational attainment, was an independent risk factor for the lack of awareness of CVD in women in our study. Household income is also known to have a much greater impact than other measures of socioeconomic status, including education, marital status, and employment status, (Shaw et al., 2008) because women may not be economically independent and

Table 4

Factors associated with no awareness (I do not know) about cardiovascular disease in women.

	Univariate		Multivariate	
	OR (95% CI)	*p*-value	OR (95% CI)	*p*-value
Age ≥ 70*	2.65 (1.968–3.579)	< 0.001	1.70 (1.147–2.519)	0.009
Level of residence, Rural[†]	1.78 (1.257–2.520)	0.001	1.46 (1.014–2.096)	0.042
Educational attainment < College[‡]	2.08 (1.625–2.661)	< 0.001	1.44 (1.078–1.917)	0.014
Household income <2000 (1000 KRW/month)[†]	2.56 (1.927–3.404)	< 0.001	1.42 (0.954–2.113)	0.084

CI, confidence interval; KRW, Korean Won; OR, odds ratio.

* Age ≥ 70 vs. Age <70.

[†] Level of residence, Rural vs. Level of residence, urban.

[‡] Educational attainment < College vs. college or higher educational attainment.

[†] Household income <2000 (1000 KRW/month) vs. Household income ≥ 2000 (1000 KRW/month).
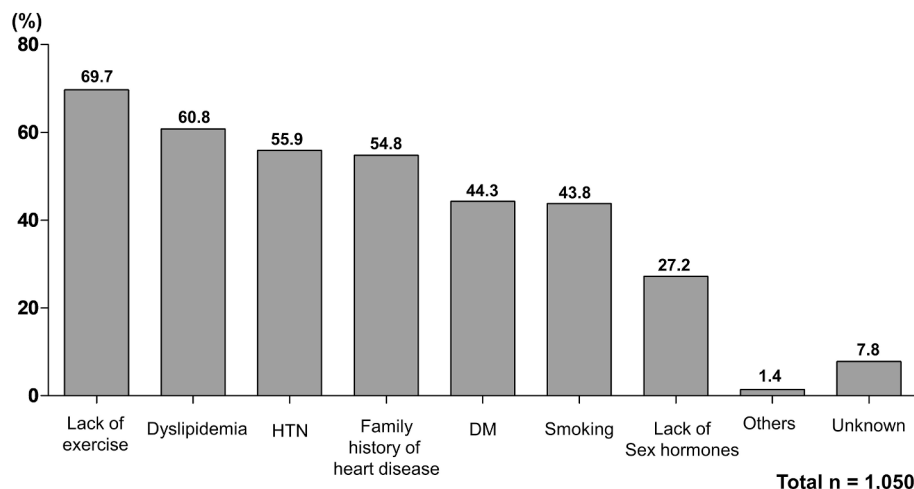

Fig. 5. Cause of cardiovascular disease. Question) What do you think is the cause of heart disease?

may depend on their husbands for household income after marriage. In our study, low household income (<2000, 1000 Korean Won/month) was associated with a tendency toward low awareness, but the association was not statistically significant.

According to the current survey, most information about CVD in women was obtained from mass media, but the proportion of participants who heard such information was small, and access to information was poor. Mass media, including television, was the most common source of information. Thus, there was no significant change in the source of information compared to that in previous studies. (Mosca et al., 2004; Pancioli et al., 1998) Although the Internet and YouTube, which were not available in the past, are now widely distributed, the most common awareness pathways in our study were television and radio. Although data was not shown in this manuscript, 22.2% in their 40 s obtained information about CVD from the Internet and YouTube, 21.9% in their 50 s, 11.9% in their 60 s, and only 3.8% of participants over 70 years of age obtained information through Internet and YouTube. These may cause a decrease in awareness among the elderly due to poor access to information about CVD, and can explain the clearly lowest level of awareness in those over 70 years old in our study. To improve the awareness about CVD in women, it is necessary to evaluate the media from which people obtain information and plan to provide information using it. In particular, a new approach using the Internet and YouTube, that can provide effective, continuous, and extensive information is needed.

Despite the lack of information, the degree of knowledge about CVD in women was not low, and the degree of knowledge regarding symptoms related to CVDs was particularly high in our study population. Considering that 52.0% of women responded that they do not know about CVD in women to the question of awareness, there was discrepancy between knowledge of CVD and awareness of CVD among them. This discrepancy may be due to the fact that awareness of CVD in women was evaluated according to the participants' subjective answer. However, the high awareness group had significantly higher knowledge level about CVD in women and the low awareness group had lower level, it is considered that the subjective answer represents a certain tendency of real awareness about CVD in women in our study. On the contrary, the degree of knowledge about management of symptomatic CVD was low. Only less than half of all participants preferred to call 119 first and contact emergency services directly, and one-third of participants preferred to go to the hospital first when they experienced a heart-breaking symptom accompanied with a cold sweat. It is important to call 119 for help and go to the hospital when experiencing these typical symptoms suggestive of CVD, but participants were less aware of these responses. In other words, to prevent death or worsening of CVD, an individual's ability to respond to emergency situations should be improved. It is necessary to share knowledge and conduct behavior correction counseling programs to ensure women are aware of appropriate responses to CVD, especially in emergency situations. In this regard, a previous study investigated the impact of a mass media campaign on comprehensive information, including the warning signs of heart attack and the appropriate actions to be taken with regard to patients with acute coronary syndrome admitted to hospitals. (Bray et al., 2015) The study showed that the awareness created by the campaign influenced participants' response to symptoms and was significantly associated with shorter pre-hospital decision-making and faster presentation to hospital. However, opinions about such campaigns are controversial, and another study reported that media campaigns about CVD, which relied on public-service advertisements on television, were not associated with an increased use of emergency medical services by women with symptoms of heart attack. (McCarthy et al., 2019) Therefore, public health campaigns through Medical organizations such as the Korean Society of Cardiology, Women's Heart Disease Research Working Group or other medical society should seek to promote awareness of and educate women on how to respond to heart attacks. In addition, women were very interested in lifestyle modification, including regular exercise,

and most believed that it could help prevent CVD. Therefore, taking this into consideration, it is necessary to expand educational opportunities and exposure by starting with topics that women are interested in.

This study had some limitations that should be considered. First, there may have been selection bias. Participants could have answered well because they were interested in health and disease, which would have made them relatively better qualified to be included in the study. In practice, awareness of CVD in women may be much lower than that assessed. Second, because our study population was restricted to Korean women, our results cannot be applied to other ethnic groups. Third, the evaluation of awareness about CVD in women was based on the participant's subjective answers, not using scoring system. However, we wanted to show the difference between how subjectively participants know about cardiovascular disease in women and what participants actually know about that through our study. The results of awareness subjectively determined by the participants may be considered meaningful.

To the best of our knowledge, our study is the first to report public awareness and knowledge of CVD in women in an Asian population. Awareness is the first step in the prevention of diseases and improving survival. In addition, awareness and knowledge of risk factors, causes, prevention, and response to symptoms of CVD are essential to change behavior and attitudes toward women's health. In order to improve public awareness of CVD in women, efforts should be made to deliver contents using CVD patient storytelling, utilize social media, develop high-quality contents, and open a window for continuous communication with medical staff. In particular, women over 70 years old, living in rural area, with low educational attainment, or low household income are high risk groups with lack of awareness about CVD, so it is necessary to develop an active education program targeting them. It is time to re-evaluate and improve the approach to education for increasing the awareness of the public. Our study helped identify the gap in knowledge and awareness and the appropriate information pathway for addressing this gap and could facilitate planning of appropriate health education programs.

5. Conclusion

Through a survey of public awareness and knowledge about CVD in women among Korean women, we found that a significant number of women are less aware of CVD in women, and lacked sources of information. Despite these points, the degree of knowledge was not low. Systematic efforts will be needed to raise awareness to help women recognize CVD as an important health issue for women.

CRediT authorship contribution statement

Hyun-Jin Kim: Conceptualization, Methodology, Software, Writing – original draft, Writing – review & editing. **Hyung Yoon Kim:** Conceptualization, Methodology, Software, Writing – original draft, Writing – review & editing. **Hack-Lyoung Kim:** Data curation, Formal analysis, Visualization. **Sang Min Park:** Data curation, Resources, Validation, Visualization. **Dong-Hyuk Cho:** Data curation, Validation, Visualization. **Mina Kim:** Data curation, Validation. **Hyun Ju Yoon:** Data curation, Investigation. **Young Sup Byun:** Data curation, Investigation, Visualization. **Seong Mi Park:** Data curation, Writing – review & editing. **Mi-Seung Shin:** Data curation, Writing – review & editing. **Kyung-Soon Hong:** Data curation, Writing – review & editing. **Myung-A Kim:** Conceptualization, Data curation, Methodology, Supervision, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2022.101698.

References

Bray, J.E., Stub, D., Ngu, P., Cartledge, S., Straney, L., Stewart, M., Keech, W., Patsamanis, H., Shaw, J., et al., 2015. Mass Media Campaigns' Influence on Prehospital Behavior for Acute Coronary Syndromes: An Evaluation of the Australian Heart Foundation's Warning Signs Campaign. J Am Heart Assoc 4.

Cushman, M., Shay, C.M., Howard, V.J., Jimenez, M.C., Lewey, J., McSweeney, J.C., Newby, L.K., Poudel, R., Reynolds, H.R., et al., 2021. Ten-Year Differences in Women's Awareness Related to Coronary Heart Disease: Results of the 2019 American Heart Association National Survey: A Special Report From the American Heart Association. Circulation 143, e239–e248.

Singapore Heart Foundation, 2020. Go Red For Women heart health survey conducted by the Singapore Heart Foundation. https://www.myheart.org.sg/my-heart/heart-statistics/women-and-heart-disease/.

Jung, M.H., Kim, H.L., Choi, J.H., Lee, S., Kong, M.G., Na, J.O., Cho, Y.H., Cho, K.I., Choi, D.J., et al., 2019. Heart failure awareness in the Korean general population: Results from the nationwide survey. PLoS One 14, e0222264.

Khan, S., Ali, S.A., 2017. Exploratory study into awareness of heart disease and health care seeking behavior among Emirati women (UAE) – Cross sectional descriptive study. BMC Womens Health 17, 88.

Kim, H.L., Jung, M.H., Choi, J.H., Lee, S., Kong, M.G., Na, J.O., Cho, Y.H., Cho, K.I., Choi, D.J., et al., 2020. Factors Associated with Low Awareness of Heart Failure in the General Population of Korea. Korean Circ J 50, 586–595.

Statics Korea, 2019. Annual report on the causes of death statistics. http://kostat.go.kr/portal/eng/pressReleases/8/10/index.board?bmode=read&bSeq=&aSeq=385629&pageNo=1&rowNum=10&navCount=10&currPg=&searchInfo=&sTarget=title&sTxt=.

Lee, S., Brick, J.M., Brown, E.R., Grant, D., 2010. Growing cell-phone population and noncoverage bias in traditional random digit dial telephone health surveys. Health Serv Res 45, 1121–1139.

McCarthy, M.L., Haynes, S., Li, X., Mann, N.C., Newgard, C.D., Lewis, J.F., Simon, A.E., Wood, S.F., Zeger, S.L., 2019. "Make the Call, Don't Miss a Beat" Campaign: Effect on Emergency Medical Services Use in Women with Heart Attack Signs. Womens Health Issues 29, 392–399.

Mosca, L., Ferris, A., Fabunmi, R., Robertson, R.M., American Heart, A., 2004. Tracking women's awareness of heart disease: an American Heart Association national study. Circulation 109, 573–579.

Mosca, L., Jones, W.K., King, K.B., Ouyang, P., Redberg, R.F., Hill, M.N., 2000. Awareness, perception, and knowledge of heart disease risk and prevention among women in the United States. American Heart Association Women's Heart Disease and Stroke Campaign Task Force. Arch Fam Med 9, 506–515.

Mosca, L., Mochari, H., Christian, A., Berra, K., Taubert, K., Mills, T., Burdick, K.A., Simpson, S.L., 2006. National study of women's awareness, preventive action, and barriers to cardiovascular health. Circulation 113, 525–534.

Mosquera, P.A., San Sebastian, M., Waenerlund, A.K., Ivarsson, A., Weinehall, L., Gustafsson, P.E., 2016. Income-related inequalities in cardiovascular disease from mid-life to old age in a Northern Swedish cohort: A decomposition analysis. Soc Sci Med 149, 135–144.

Pancioli, A.M., Broderick, J., Kothari, R., Brott, T., Tuchfarber, A., Miller, R., Khoury, J., Jauch, E., 1998. Public perception of stroke warning signs and knowledge of potential risk factors. JAMA 279, 1288–1292.

Rosengren, A., Smyth, A., Rangarajan, S., Ramasundarahettige, C., Bangdiwala, S.I., AlHabib, K.F., Avezum, A., Bengtsson Bostrom, K., Chifamba, J., et al., 2019. Socioeconomic status and risk of cardiovascular disease in 20 low-income, middle-income, and high-income countries: the Prospective Urban Rural Epidemiologic (PURE) study. Lancet Glob Health 7, e748–e760.

Schultz, W.M., Kelli, H.M., Lisko, J.C., Varghese, T., Shen, J., Sandesara, P., Quyyumi, A. A., Taylor, H.A., Gulati, M., et al., 2018. Socioeconomic Status and Cardiovascular Outcomes: Challenges and Interventions. Circulation 137, 2166–2178.

Shaw, L.J., Merz, C.N., Bittner, V., Kip, K., Johnson, B.D., Reis, S.E., Kelsey, S.F., Olson, M., Mankad, S., et al., 2008. Importance of socioeconomic status as a predictor of cardiovascular outcome and costs of care in women with suspected myocardial ischemia. Results from the National Institutes of Health, National Heart, Lung and Blood Institute-sponsored Women's Ischemia Syndrome Evaluation (WISE). J Womens Health (Larchmt) 17, 1081–1092.

Varleta, P., Acevedo, M., Casas-Cordero, C., Berrios, A., Navarrete, C., 2020. Low Cardiovascular Disease Awareness in Chilean Women: Insights from the ESCI Project. Glob Heart 15, 55.

Vital Statistics Division, S.K., Hyun-Young Shin, Jin Kim, Seokmin Lee, Min Sim Park, Sanghee Park, Sun Huh, 2020. Cause-of-death statistics in 2018 in the Republic of Korea. Journal of the Korean Medical Association 63:286-97.