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ORIGINAL RESEARCH

A study on the subjectivity perception of the risk of cardiovascular disease in male driver workers: Q methodological approach

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Abstract

The purpose of this study was to confirm subjective perceptions of cardiovascular disease risk among professional male drivers. Using the Q-methodology, we systematically analyzed and classified subjective perceptions of cardiovascular disease risk among professional drivers, thus identifying characteristics of each type. Q methodology, which is a research method to study people's subjective points of views, was used. 34 Q-statements (Q-sample) were derived from the Q population (Concourse) and were arranged in rank order by each of 35 participants into a normal distribution grid (from −4 to +4). A QUANL program was used to analyze the collected data. The subjective perceptions of cardiovascular disease risk among professional male drivers were classified into four types: first, the risk detection type; second, the prevention effort type; third, the symptom recognition type; and finally, the risk neglect type. Efforts should be made to maintain the physical and mental health promotion of the subjects, including education on symptoms related to cardiovascular disease, awareness and prevention of high-risk factors and severity, and various efforts. Furthermore, it is necessary to develop and implement tailored health promotion programs for preventing cardiovascular disease, considering the diverse characteristics of professional drivers.

Keywords

Driver; Cardiovascular disease; Risk; Subjective

1. Introduction

1.1 Significance of the study

Long hours of work for drivers expose them to chronic diseases due to factors such as lack of physical activity, irregular eating habits, restroom access issues, shift work, work-related stress due to traffic conditions, and emotional stress from passenger interactions [1]. According to statistics from the Korea Occupational Safety and Health Research Institute, the main diseases reported among drivers include hypertension, cardiovascular diseases, liver diseases, and diabetes [2]. Cardiovascular diseases encompass chronic heart diseases, cerebrovascular diseases, peripheral arterial diseases, and heart failure. In South Korea, cardiovascular diseases rank second only to cancer as a leading cause of death. The incidence of cardiovascular diseases has significantly increased from 46.9 per 100,000 people in 2010 to 62.4 in 2018 [3]. Cardiovascular diseases pose serious health risks, ranking as the second leading cause of death in South Korea after cancer. Cardiovascular diseases account for over 50% of work-related fatalities among workers, with 90% occurring in males [4]. Preventing the onset of cardiovascular diseases through lifestyle modifications and improvements in the work environment is cost-effective, as it reduces the burden on individuals, companies, and the

nation [3]. Failure to address or prevent these diseases may lead to personal health complications, as well as social and economic losses. However, many male workers in South Korea underestimate their risk of cardiovascular diseases [5] and demonstrate low levels of engagement in health-promoting behaviors [6]. Due to the nature of their occupation, drivers are vulnerable to health issues such as abdominal obesity and various chronic diseases [7]. Prolonged employment exceeding ten years is associated with an increased risk of cardiovascular diseases, musculoskeletal disorders, mental disorders, respiratory diseases, neurological disorders, endocrine disorders, and metabolic diseases [8]. Drivers face health issues related to changes in their circadian rhythms during night shifts, prolonged exposure to noise and vibration stress, alternate shifts, mental stress from safely transporting passengers to their destinations, and physical stress, leading to a higher prevalence of gastrointestinal discomfort, depression, and other symptoms [9]. Therefore, it is necessary to develop and implement cardiovascular disease prevention programs that address sedentary behavior, poor dietary habits, obesity, stress, and hyperlipidemia among male workers in South Korea. This study aims to explore the awareness of cardiovascular disease risk among drivers, as this awareness influences their coping mechanisms and behaviors. The per-

ception of cardiovascular disease risk among drivers is highly individualized and subjective. Therefore, employing the Q-methodology, which objectively measures subjects' reactions and explores their internal perceptions, feelings, attitudes and response types, is crucial [10]. This study seeks to provide foundational data for establishing effective strategies for managing cardiovascular disease risk among drivers based on their accurate perceptions.

1.2 Purpose

This study aims to typify and characterize the perception of cardiovascular disease risk among male drivers in the transportation sector. The specific objectives are outlined as the firstly, typify the perception of cardiovascular disease risk among male drivers in the transportation sector, and secondly, analyze and describe the characteristics of perception regarding cardiovascular disease risk among male drivers, categorized by typology.

2. Materials and methods

2.1 Study design

This study is an exploratory research that applies the Q methodology to identify and categorize the subjectivity of perception regarding the risk of cardiovascular diseases among male drivers. The aim is to classify, analyze and describe the various typologies of perception through the application of Q methodology.

2.2 Study sampling

2.2.1 Selection of the Q-population and Q-samples

For Q statement collection, in-depth interviews were conducted with drivers, considering the sub-dimensions of cardiovascular disease risk. The audio recordings of the interviews were transcribed and analyzed, along with a review of relevant literature. In-depth interviews for Q population composition were conducted with a total of 20 drivers from 01 January 2023, to 30 January 2023. During these interviews, participants were asked about their perceptions of cardiovascular disease risk among drivers and the preventive measures they believed should be taken. Interviews continued until responses on the risk of cardiovascular disease were saturated. Additionally, participants were deeply interviewed about their experiences while driving, knowledge of cardiovascular diseases, and preventive measures. Each interview lasted approximately 1 to 2 hours, and all discussions were recorded and documented to prevent omissions. Furthermore, a total of 350 Q statements were extracted, including data from previous studies, specialized literature, and domestic academic journals. Through a process of discussion among three nursing professors and subsequent extraction and refinement of statements, a total of 150 Q statements were finalized. To select Q samples, statements were categorized based on common themes or values perceived through multiple readings. Positive and negative statements were balanced, and ambiguous sentences were clarified to match the level of understanding of the participants [11]. This

iterative process resulted in the categorization of cardiovascular disease risk into four categories, with each category containing varying numbers of statements ranging from 19 to 112. The categorization process was further refined through consultation with two nursing professors experienced in Q methodology research. Finally, a total of 34 statements were selected as the final Q sample.

2.2.2 Selection of the P-samples

In Q methodology, the number of P samples is typically around 40 ± 20. Therefore, in this study, P samples consisted of a total of 35 male taxi drivers selected by the researcher, including participants who agreed to participate in the study and those who participated in in-depth interviews for the composition of the Q population. Male taxi drivers were selected from Seoul, Gyeonggi Province, Daegu, and Gangwon Province, considering factors such as age, and driving experience. Sample selection was conducted through convenience sampling and snowball sampling methods based on recommendations from acquaintances.

2.2.3 Classification of the Q-samples and data analysis

The Q classification procedure, conducted from 01 September to 30 September 2023, adhered to the methodological principles of Q methodology. Thirty-five statements selected from the P sample were strategically distributed during this period. The preparation of the Q sample distribution, comprising 34 statements derived from research participants, was guided by the tenets of Q methodology.

Preceding the Q classification, participants underwent a comprehensive familiarization process with all statements, supplemented with clarifications to address any inquiries, ensuring a nuanced comprehension. The allocation of Q samples transpired in a conducive environment conducive to facilitating clear observation of the distribution pattern, with ample space to accommodate the classification process.

The commencement of Q classification involved participants categorizing statements into three groups: positive, neutral, and negative. Sequentially, the most favorably rated statements were selected from the positive category and arranged from the outer to inner segments, culminating in the neutral section. For pairs of statements positioned at the extremes (+4, −4), pertinent comments were provided to facilitate subsequent interpretation of Q factors [12].

Data collected were methodically scored on a scale from 1 (most negative) to 9 (most positive) based on the Q sample distribution. Subsequent analysis utilized the PC-QUANL Program, incorporating varied factor inputs to discern the optimal number of factors. Criteria for selection were anchored on factors such as eigenvalue and total variance explained, culminating in the identification of the most conceptually cogent classification type [13].

3. Results

3.1 Formation of the Q-types

The subjectivity of perception regarding the risk of cardiovascular disease among professional drivers was analyzed using Q factor analysis, resulting in the extraction of four distinct types. These four types accounted for 51% of the total variance, with each type explaining 16.8% for Type 1, 7.73% for Type 2, 6.59% for Type 3 and 5.76% for Type 4 (see Table 1). Additionally, the correlations between the four types are presented in Table 2, demonstrating the degree of similarity between each type. The correlation coefficients (r) ranged from ± 0.12 to 0.56, indicating a moderate level of similarity between the types, suggesting their relatively independent existence.

T A B L E 1. Eigen value, variance, and cumulative percentage (N = 35).

Variables	Type 1	Type 2	Type 3	Type 4
Eigen value	5.89	2.70	2.31	2.00
Variance (%)	16.83	7.73	6.59	5.76
Cumulative variance	0.17	0.25	0.31	0.37

T A B L E 2. Correlation matrix between types (N = 35).

Variables	Type 1	Type 2	Type 3	Type 4
Type 1	1.00			
Type 2	0.31	1.00		
Type 3	0.22	0.49	1.00	
Type 4	0.56	0.12	0.19	1.00

3.2 Characteristics of the types

The composition of study subjects revealed that there were 11 individuals in Type 1, 9 in Type 2, 9 in Type 3 and 6 in Type 4. The demographic characteristics and factor loading of each type are presented in Table 3. Higher factor loadings within each type indicate individuals who typify the characteristics of that type. To analyze the subjectivity of perception regarding the risk of cardiovascular disease among professional drivers, strong positive (Z score $\geq +1$) and strong negative (Z score ≤ -1) items among the total 35 statements were interpreted. The characteristics of each type were based on items where the standard scores for a specific type differed significantly from those of other types. The identified types of cardiovascular disease perception among professional drivers were as follows (see Table 3).

If a participant has a high loading (≥ 0.8) on one factor, they represent the Q factor, and special attention should be paid to the opinions and demographic information of participants classified into Q types, based on the content of the study reflecting the effort to classify the perception types of cardiovascular disease risk among professional drivers [10]. In addition, to determine the optimal type of classification, analyses were conducted with 2–5 factors specified. However,

the results showed that the Q types with the highest misloading were represented by four factors (see Table 4).

3.2.1 Type 1: "risk detection type"

The strongest agreement from Type 1 was observed in the items "Often eat supper before going to bed ($Z = 1.63$)" and "Drink alcohol every evening because of the stress of work ($Z = 1.39$)". Conversely, the strongest disagreement was observed in the items "Feel heavy-hearted as if living with the risk of cardiovascular disease ($Z = -3.46$)" and "Worried that cardiovascular disease might occur ($Z = -1.95$)". Furthermore, compared to Type 2, Type 1 showed a score difference of +1.00 or more in strong agreement for the items "Often eat supper before going to bed ($Z = 1.63$)" and "Continuous fatigue can lead to cardiovascular disease ($Z = 1.39$)", while showing a score difference of -1.00 or more in strong disagreement for the items "Feel heavy-hearted as if living with the risk of cardiovascular disease ($Z = -3.46$)" and "Making efforts to abstain from drinking ($Z = -1.51$)". Similarly, compared to Type 3, Type 1 showed a score difference of +1.00 or more in strong agreement for the items "Often eat supper before going to bed ($Z = 1.63$)" and "Continuous fatigue can lead to cardiovascular disease ($Z = 1.39$)", while showing a score difference of -1.00 or more in strong disagreement for the items "Feel heavy-hearted as if living with the risk of cardiovascular disease ($Z = -3.46$)" and "Making efforts to abstain from drinking ($Z = -1.51$)". Lastly, compared to Type 4, Type 1 showed a score difference of +1.00 or more in strong agreement for the items "Often eat supper before going to bed ($Z = 1.63$)" and "Continuous fatigue can lead to cardiovascular disease ($Z = 1.39$)", while showing a score difference of -1.00 or more in strong disagreement for the item "Feel heavy-hearted as if living with the risk of cardiovascular disease ($Z = -3.46$)". Based on these results, Type 1 was named "Risk Detection Type", as professional drivers in this type detect the risks of cardiovascular disease in their daily habits and make efforts to prevent it.

3.2.2 Type 2: "effort for prevention type"

The strongest agreement from Type 2 was observed in the items "Regularly undergo health checkups for prevention ($Z = 2.24$)" and "Wear compression stockings or other devices for blood circulation ($Z = 1.92$)". Conversely, the strongest disagreement was observed in the item "Try to eat less salty and eat bland food ($Z = -2.44$)". Furthermore, compared to Type 3, Type 2 showed a score difference of +1.00 or more in strong agreement for the items "Regularly undergo health checkups for prevention ($Z = 2.24$)" and "Feel weak, dizzy, and have blurred vision, which is risky ($Z = 1.10$)", while showing a score difference of -1.00 or more in strong disagreement for the items "Feel heavy-hearted as if living with the risk of cardiovascular disease ($Z = -3.06$)" and "Often eat supper before going to bed ($Z = -1.77$)". Similarly, compared to Type 4, Type 2 showed a score difference of +1.00 or more in strong agreement for the items "Regularly undergo health checkups for prevention ($Z = 2.24$)" and "Feel weak, dizzy, and have blurred vision, which is risky ($Z = 1.10$)", while showing a score difference of -1.00 or more in strong disagreement for the items "Feel heavy-hearted as if living with the risk

TABLE 3. Demographic characteristics and factor weight for P-sample (N = 35).

Type	Var no.	Factor weight	Average driving time (h)	Age	Driving tenure	Presence of disease	Type of disease
Type 1 (n = 11)							
	4	0.54	9	56	1–5	have	Diabetes
	12	0.25	10	49	5–10	don't have	-
	16	0.36	11	55	5–10	don't have	-
	18	0.35	8	55	1–5	have	Cardiovascular Disease
	19	0.56	12	54	5–10	have	Hypertension
	20	0.74	12	48	5–10	don't have	-
	29	0.39	12	54	5–10	have	Diabetes
	30	0.29	12	58	5–10	have	Diabetes
	31	0.60	9	56	5–10	don't have	-
	32	0.39	9	48	10–15	don't have	-
	33	1.32	8	52	5–10	have	Cardiovascular Disease
Type 2 (n = 9)							
	1	0.77	8	60	5–10	have	Hypertension
	3	0.66	8	60	10–15	have	Hypertension
	10	0.46	7	49	5–10	have	Cardiovascular Disease
	13	0.86	9	48	5–10	have	Hypertension
	15	0.32	10	47	5–10	have	Hypertension
	24	0.31	12	49	5–10	have	Hypertension
	25	1.01	12	56	5–10	don't have	-
	26	0.66	12	56	5–10	don't have	-
	35	0.20	9	55	5–10	don't have	-
Type 3 (n = 9)							
	5	0.73	12	56	5–10	have	Hypertension
	6	0.60	12	56	1–5	have	Diabetes
	7	0.83	9	60	5–10	have	Hypertension
	8	0.81	9	60	5–10	have	Hypertension
	9	0.46	9	60	1–5	have	Hypertension
	11	0.43	9	55	15–20	don't have	-
	23	0.29	9	55	5–10	have	Hypertension
	27	0.66	12	50–55	5–10	don't have	-
	28	0.37	12	50–55	5–10	don't have	-
Type 4 (n = 6)							
	2	0.44	12	56–60	1–5	have	Hypertension
	14	0.36	10	50–55	5–10	have	Hypertension
	21	0.59	9	56–60	10–15	have	Hypertension
	17	1.13	9	40	10–15	don't have	-
	22	0.54	9	50–55	5–10	don't have	-
	34	1.01	9	50–55	5–10	don't have	-

T A B L E 4. Representative Q-samples and *Z*-scores in Types (N = 35).

Type	No.	Statement	Z-score
Type 1 Risk detection type	n = 11	I am aware of the importance of managing Hypertension and Diabetes.	1.63
		It's risky to drink every night because of work stress.	1.39
		I feel stressed while driving, which I believe is risky.	1.37
		I search and watch YouTube for preventing cardiovascular diseases.	1.21
		I need to know about cardiovascular disease and prevention methods.	1.17
		I often have late-night snacks before going to bed.	−0.10
		I try to get at least 7 hours of sleep per day.	−0.15
		I plan to exercise regularly at least 3 times a week.	−1.17
		I eat vegetables other than kimchi with every meal.	−1.31
		I'm worried that I might develop cardiovascular disease.	−1.51
		I feel burdened by the thought of living with the risk of cardiovascular disease.	−3.46
Type 2 Effort for prevention type	n = 9	I try to receive regular check-ups to prevent illnesses.	2.24
		I wear compression stockings or other circulation aids.	1.92
		Abdominal obesity may lead to cardiovascular diseases.	1.89
		I make efforts to be physically active whenever I have time while driving.	1.73
		Being cautious about living with the management of cardiovascular diseases is challenging.	1.48
		I strive for a balanced diet and weight management.	−1.31
		I spend most of my time sitting, which could lead to cardiovascular diseases.	−1.66
		I enjoy meat and fatty foods.	−1.90
		I try not to eat salty foods and prefer bland ones.	−2.44
Type 3 Symptom recognition type	n = 9	Spending a lot of time driving can cause my legs to ache and feel stiff, which I find risky.	2.11
		Feeling weak, dizzy, and experiencing blurred vision are signs of danger.	2.17
		I make efforts to manage my work-related stress.	1.97
		I consider shortness of breath as a symptom of cardiovascular disease.	1.21
		Irregular eating habits lead to being overweight or obese.	−1.22
		Cardiovascular disease can arise from sustained exertion.	−1.38
		I manage my high cholesterol.	−1.64
		I consider pain or discomfort in my jaw, neck, or back as symptoms of cardiovascular disease.	−1.72
		I consider chest pain or discomfort as symptoms of cardiovascular disease.	−2.33
Type 4 Risk neglect type	n = 6	I enjoy eating instant food or fast food.	1.94
		I have a sweet tooth and tend to overeat.	1.66
		I am trying to quit smoking.	1.51
		I am trying to abstain from alcohol.	−1.18
		Cardiovascular disease can arise from sustained exertion.	−1.30
		Managing and living with cardiovascular disease prevention feels burdensome.	−1.48

of cardiovascular disease ($Z = -3.06$)" and "Often eat supper before going to bed ($Z = -1.77$)". Based on these results, Type 2 was named "Effort for Prevention Type", as professional drivers in this type make efforts to prevent cardiovascular disease by using devices and undergoing regular checkups.

3.2.3 Type 3: "symptom recognition type"

The strongest agreement from Type 3 was observed in the items "When driving for a long time, legs feel numb and tingly, which is risky ($Z = 0.11$)" and "Feel weak, dizzy, and have blurred vision, which is risky ($Z = 2.17$)". Conversely, the strongest disagreement was observed in the items "Consider chest pain or discomfort as symptoms of cardiovascular disease ($Z = -2.33$)" and "Consider pain or discomfort in the jaw, neck or back as symptoms of cardiovascular disease ($Z = -1.72$)". Furthermore, compared to Type 4, Type 3 showed a score difference of $+1.00$ or more in strong agreement for the items "Making efforts to abstain from drinking ($Z = 2.06$)" and "Like meat or greasy food ($Z = 1.61$)", while showing a score difference of -1.00 or more in strong disagreement for the items "Feel heavy-hearted as if living with the risk of cardiovascular disease ($Z = -3.67$)" and "Search and watch YouTube to prevent cardiovascular disease ($Z = -1.37$)". Based on these results, Type 3 was named "Symptom Recognition Type", as professional drivers in this type recognize various symptoms of cardiovascular disease and experience significant worry.

3.2.4 Type 4: "risk neglect type"

The strongest agreement from Type 4 was observed in the items "Enjoy instant food or fast food ($Z = 1.94$)" and "Like sweet food and overeat ($Z = 1.66$)". Conversely, the strongest disagreement was observed in the items "Feel burdened to live by managing to prevent cardiovascular disease ($Z = -1.48$)" and "Continuous fatigue can lead to cardiovascular disease ($Z = -0.130$)". Based on these results, Type 4 was named "Risk Neglect Type", as professional drivers in this type neglect the risks of cardiovascular disease, enjoy unhealthy eating habits, and feel burdened by preventive measures.

3.3 The items agreed or disagreed upon by every type

In the results above, it can be seen that the subjectivity of perception regarding the risk of cardiovascular disease among professional drivers is divided into four distinct types, each showing clear characteristics. However, some statements were commonly agreed upon or opposed across the four types regarding the risk of cardiovascular disease, which are presented in Table 5. The item that showed strong agreement regarding the perception of the risk of cardiovascular disease among professional drivers was "Feeling heavy-hearted as if living with the risk of cardiovascular disease".

TABLE 5. Consensus items and average Z-scores (N = 35).

	Q-statement	Z-scores
Q32	Feeling heavy-hearted as if living with the risk of cardiovascular disease.	3.461

4. Discussion

The subjectivity provides a prototype that determines how individuals internalize emotional states related to psychological events, influencing the evaluation of human behavior [13]. This study attempted to apply the Q methodology, which starts from the subjectivity of the research subjects rather than the researcher's perspective, to identify the subjectivity of cardiovascular disease risk perception among drivers and to classify types.

As a result, four types were classified: "Risk Detection Type", "Effort for prevention type", "Symptom recognition type" and "Risk Neglect Type". Each type of subject was classified as follows: 11 subjects in Type 1, Risk detection type, of which 6 (54.5%) had the disease; 9 subjects in Type 2, Effort for prevention type, of which 6 (66.7%) had the disease; 9 subjects in Type 3, Symptom recognition type, of which 6 (66.7%) had the disease; and 6 subjects in Type 4, Risk neglect type, of which 3 (50%) had the disease. In Types 2 and 3, the number of disease patients reported was higher compared to Types 1 and 4. Strong agreement was observed for items such as "Regularly undergo regular checkups for prevention" and "Wear auxiliary devices for blood circulation, such as compression stockings", in Type 2, Effort for prevention type, and items such as "After driving for a long time, my legs ache and feel numb, which I consider risky" and "I feel weak, dizzy, and my vision blurs, which I consider risky" in Type 3, Symptom recognition type. This is similar to the research results reported by Kong, Choi & Oh, indicating that individuals with cardiovascular disease have a higher awareness of the disease [14], suggesting that the subjects in this study have a higher awareness of the disease than those who detect or neglect the risk. Similar results were observed, compared to the report that unhealthy behavior groups with cardiovascular risk factors had lower health behavior rates for cardiovascular disease prevention [15], opposite results were observed, suggesting that awareness of cardiovascular disease is an important issue for both patients and those who are unaware of the disease. Therefore, it is necessary to raise awareness of the severity of cardiovascular diseases among drivers who engage in prolonged sedentary work and apply interventions for disease prevention to the subjects.

For Type 1 drivers, their awareness of cardiovascular disease risk is called "Risk detection type" because they express concern and fear about cardiovascular disease themselves, detect risks in their daily lifestyles, and make efforts to prevent cardiovascular disease. Perception of the risk of cardiovascular disease refers to an individual's subjective perception of the risk of encountering cardiovascular disease and the expected physical and social consequences if they have or do not treat the disease [16]. Park, Ko, & Park stated in their study on the risk perception of cardiovascular diseases among taxi drivers that the vulnerability perceived by the subjects was mostly related to lack of exercise, difficulty in regular meals, and high stress levels, making them susceptible to cardiovascular diseases [16]. Ko's study on taxi drivers also revealed that their health status was relatively poor, and there was an urgent need for health promotion behaviors and improvement in health perception [17]. By identifying factors influencing drivers'

perceptions of cardiovascular diseases, continuous education and promotion in the workplace and local communities are needed to continuously raise awareness of risk among taxi drivers [16]. Drivers in Type 1 are aware of the risks of cardiovascular diseases, detect risks in their daily lifestyles, and make efforts to prevent cardiovascular diseases, so improvements are needed to facilitate education on cardiovascular disease risks and lifestyle changes. To reduce these risks, guidance is needed for drivers to manage themselves, such as taking breaks and self-management during driving, considering their work environment and characteristics of prolonged driving and sedentary activities.

For Type 2 drivers, their awareness of cardiovascular disease risk is named "Effort for prevention type" because they use auxiliary devices for blood circulation or undergo regular check-ups to prevent cardiovascular diseases. Moreover, their efforts to overcome all these issues and treat cardiovascular diseases demonstrate their focus on prevention. In a study on attitudes toward cardiovascular disease prevention among male workers, it was emphasized that improving attitudes toward prevention, such as smoking prevention, management of pre-existing diseases, and exercise, is important through active promotion of industrial health and worker health management centered on health centers [14]. Another study pointed out that the main factors affecting health promotion practices are the individual's health status, and individuals need to maintain harmony in health maintenance and improvement [18], indicating the need for measures such as smoking cessation, exercise, and stress management. Combining these previous studies, the main risk factors for cardiovascular diseases are lack of exercise, obesity, smoking, stress, and unhealthy eating habits, leading to cardiovascular and metabolic diseases [19]. Subjects in Type 2 showed strong agreement with items such as the use of auxiliary devices for blood circulation due to long hours of driving and recognition of the importance of regular check-ups, so continuous education on cardiovascular diseases and development and application of educational and practical programs for health promotion and prevention are necessary for drivers. Drivers need to continue health promotion and practice for cardiovascular disease prevention, and continuous motivation and management are necessary to motivate them.

For Type 3 drivers, their awareness of cardiovascular disease risk is called "Symptom recognition type" because they experience symptoms such as leg numbness, weakness, blurred vision, chest pain, or discomfort associated with cardiovascular diseases and have concerns. Park *et al.* [17] stated that if individuals recognize the vulnerability to cardiovascular diseases and identify obstacles themselves, it is easier to approach preventive interventions to improve problems [16]. Furthermore, taxi drivers are motivated to practice preventive behaviors when they hear that their acquaintances have fallen ill or become aware of their health, suggesting the need for continuous management to motivate subjects to practice preventive behaviors [16]. Drivers are exposed to cardiovascular disease due to long driving hours and limited rest time, leading to various health problems [7]. According to data from the National Health Insurance Corporation, men in their 50s are often suspected of hypertension and diabetes, and more than 50% are considered at risk of metabolic syndrome [20]. Park

measured the health status of workers and stated that the risk of metabolic syndrome is high based on the results of overweight, severe obesity, pre-hypertension, and impaired fasting glucose [21, 22]. These previous studies explain that drivers are exposed to the risk of cardiovascular diseases due to their age, gender, and characteristics of work types. Therefore, tailored nursing interventions based on the characteristics and high risk of drivers should be implemented.

For Type 4 drivers, their awareness of cardiovascular disease risk is called the "Risk neglect type" because they eat instant foods or fast food, prefer sweet foods, overeat and feel burdened by continuous fatigue or management for preventing cardiovascular diseases. Ko's study showed that taxi drivers lack active interventions for individual risk factors, and most of them are middle-aged, so lifestyle improvements and changes in health perception are urgently needed [17]. Kim & Hwang analyzed seven risk factors for cardiovascular diseases among men and explained that the rate of unhealthy behavior groups with high rates of smoking and heavy drinking was 51.8%, and these groups showed low intentions for health information-seeking behavior and mobile health use and reported low rates of health behavior for cardiovascular disease prevention [15]. Therefore, mobile health interventions described in previous studies are needed for preventive efforts of these subjects, and more proactive use should be encouraged. Furthermore, providing more professional cardiovascular disease-related health information and strategies to increase awareness and practice of these strategies is important. Additionally, providing guidance on more acceptable lifestyle changes that drivers would be willing to embrace would be helpful.

The item with the strongest agreement among drivers regarding awareness of the risk of cardiovascular disease was "It feels heavy to live with the risk of cardiovascular disease". Thus, drivers in the occupation group are more concerned and worried about the risk of cardiovascular disease than other occupation groups. Park *et al.* [17] stated that subjects recognize vulnerability, seriousness, and benefits regarding the risk of cardiovascular diseases, recognize them themselves, and ultimately try to improve their health management [16, 22]. Considering these results, subjects recognize the risk of cardiovascular diseases, so tailored education and intervention programs should be developed and applied to promote subjects to change themselves.

The significance of focusing on a specific occupational group, namely professional drivers, lies in identifying the subjective perceptions of cardiovascular disease risk, including risk factors and awareness within this group. Furthermore, the results of this study can help develop suitable education and prevention strategies for each identified type. The limitations of this study include its focus on a specific occupational group, which makes it difficult to generalize to the general male population or other occupational groups. Additionally, since the study is based on subjective perceptions, the results may be influenced by individual emotions or perceptions.

5. Conclusions

This study aimed to develop basic data for establishing fundamental strategies for developing subjective research on the risk of cardiovascular disease among drivers and to confirm the structure of the risk of cardiovascular disease by classifying and describing the characteristics of types based on the subjective perception of the risk of cardiovascular disease among drivers and to establish basic strategies for preventing cardiovascular diseases among drivers. As a result of this study, subjective perceptions of the risk of cardiovascular disease among drivers were classified into four types: "Risk detection type", "Effort for prevention type", "Symptom recognition type" and "Risk neglect type". In each type, subjects were detecting risks according to their recognition of cardiovascular diseases, making efforts to prevent them by using auxiliary devices or receiving regular check-ups, recognizing symptoms themselves, or perceiving risks but neglecting them. Therefore, efforts should be made to maintain the physical and mental health promotion of subjects, including education on symptoms and various efforts to recognize and prevent high-risk groups and risks for drivers' cardiovascular disease risks. Furthermore, it is necessary to develop and apply tailored health promotion programs for preventing cardiovascular diseases based on the diverse characteristics of drivers.

AVAILABILITY OF DATA AND MATERIALS

Not applicable.

AUTHOR CONTRIBUTIONS

SJP, BJP, BSP and GYK—Study conception and design acquisition; analysis and interpretation of the data. BSP and GYK—rafting and critical revision of the manuscript. SJP and BJP—Data collection. SJP—Discussion and conclusions, suggestions. SJP and GYK—English review. BJP, BSP and GYK—Abstract and References and Final Submission. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Passed review by the Clinical Trial Review Committee of Daegu Health College, Korea (IRB No. DHCIRB-2022-03-0002). Informed consent has been obtained from the participants involved.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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