The Factors Affecting Bicycle Riding Under the Influence in Korean Adults: The Korea National Health and Nutrition Examination Survey

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Abstract: This study was conducted to identify the impact factors of bicycle driving under the influence (DUI) among Korean adults. The participants were 1,297 Korean adults. The prevalence of bicycle DUI was 11.7% of Korea adults. The factors affecting bicycle DUI were gender, education level, frequency of drinking, one-time drinking, vehicle DUI. To prevent bicycle DUI, we would need to facilitate appropriate drinking habits, provide treatments for disorders related to alcohol use, and change the social perception of bicycle DUI. Also, we should promote the establishment of the culture of bicycle helmet use, the establishment of a system that imposes fine to non-helmet-using riders, and education and publicity on the national level to recognize that bicycle DUI and DUI are mutually related.

Keywords: Drunk Driving; Bicycling; Helmets; Intoxication; Alcoholic

1. Introduction

Recently in Korea, the number of bicycle traffic accidents and the number of injured persons is increasing as the number of bicycle users increases due to the expansion of society-wide bicycle infrastructure and the activation policy [1]. According to statistics, the number of bicycle traffic accidents in 2015 was 17,336, an increase of 4.2% from the previous year, and the number of injured persons was 16,114, an increase of 4.5% from the previous year [2].

Bicycle traffic accidents occurred due to various reasons including violation of safe driving duties, violation of centerline, violation of signals, violation of crossroad traffic regulations, failure to assure safety distance, and violation of pedestrian protection obligations. Among the factors, violation of safe driving duties was the primary cause [2], which is related to bicycle riding under the influence of alcohol – hereafter, bicycle driving under the influence (DUI) – and bicycle helmet use, the social issues recently recognized [3].

Korea has had laws on bicycle DUI and bicycle helmet use but has never had strongly enforced the regulations of bicycle DUI, and only children were required to wear bicycle helmets [4]. Recently, however, the government established enforcement of imposing fine of 200,000 won when caught in a crackdown on DUI, and the subject to the mandatory use of bicycle helmets is extended to any riders and passengers as the law was amended [4]. It is now that the social discourse of establishing the culture of safe bicycle use is emerging [5].

Bicycle DUI, like DUI of automobiles, slows the rider's reaction speed, reduce the sense of balance and judgment, and is a direct cause of traffic accidents [6]. The traffic accidents from bicycle DUI can cause multiple injuries of the head, face, chest, abdomen, limbs, and skin, and so forth or considerable period the aftereffect and disability [7]. Moreover, the higher the blood alcohol level of bicycle rider may increase the risks of damage [8]. The drinking bicycle riders had a fatal damaged traffic accident than the non-drinking rider due to lesser helmet wear rate [14].

The bicycle helmet use can reduce such risks of damage. A head model experiment reported that use a bicycle helmet decreased risks of multiple injuries as it is less likely for helmet-users to hurt themselves compared to non-helmet users, as the instances of having head injury decreased by 8-17% [9]. Another study reported that using a helmet while bicycling reduces the risk of traffic accidents [10]. Therefore, recognition of

the risks of bicycle DUI and paying attention to the importance of bicycle helmet use would be significant for the change of safety awareness to the bicycle riding.

The bicycle DUI is related to personality factors, lifestyle factors, drinking habit factors, and safety awareness factors. Among the personal factors, male, rural residence, low education level, and adult living with a spouse demonstrates higher significance [11], and experience of bicycle DUI is related to subjective norms and attitude toward bicycle DUI [12]. In the lifestyle factors, the current smoker is a factor with higher significance, and in the drinking habits, the higher the amount of alcohol consumed and the more the alcohol use-related disorders, the higher relevance to the experience of bicycle DUI was found. In the safety awareness factors, having experience of vehicle DUI or non-use of a belt while riding showed higher significance [11]. Moreover, the drinking bicycle riders were helmet wear rate lesser than the non-drinking rider [14].

In examining the prior studies related to bicycle DUI in Korea, there were a study conducted surveys on risk factors of bicycle DUI [11], a study on relevance to bicycle DUI and DUI [13], and a survey on significance to bicycle DUI and bicycle accident injury [7], and so forth. In examining the studies in the foreign context, there were a study on relevance to bicycle DUI and subjective norms and attitude toward bicycle DUI [12], a survey on significance of blood alcohol level and bicycle accidents and use a bicycle helmet [14], and a study on relevance to bicycle DUI and severity of bicycle accidents [15], and so forth.

As examined above, not only the personality factors, lifestyle habits, drinking habits but also, safety awareness was related to bicycle DUI. Moreover, recently, a change in safety awareness concerning safe bicycle use has become a social issue in Korea. Nevertheless, only a few studies investigated factors affecting Bicycle DUI that including helmet wear variable directly related to the safety of bicycle rider.

Therefore, this paper provides primary data for the change of safety awareness by using data from the Seventh Korea National Health and Nutrition Examination Survey (KNHANES, 2016) to verify the relevance to bicycle helmet wearing and bicycle DUI, and the factors affecting bicycle DUI.

2. Methods

2.1 Research design

This study applies a longitudinal secondary data analysis using data from the Seventh Korea National Health and Nutrition Examination Survey (KNHANES, 2016). The purpose of this study is to identify, the factors affecting bicycle DUI including helmet wear variable of the Korean adults over 19 years of age.

2.2 Research participants

Participants in Seventh KNHANES (2016) were 10,806, of which, 8,150 participated in one or more of the health survey, examination survey, nutritional survey. Among them, 7,804 participants over 19 years of age participated in the health survey and examination survey. The final subject group of participants was composed of 1,297 as classified as to those had experiences of bicycle DUI or not during a year. I used the whole data as the data for analysis to reduce the standard error bias of the estimates and to select interest groups as those who are over 19 years of age, and below 19 years of age. The interest group was designated as a parent group and thus, analyzed with both respondents and non-respondents were given weight.

3. Measurements

The questionnaire used in this study is the checkup questionnaire (basic survey) and the health questionnaire (adults) of the Seventh KNHANES (2016). Each measurement was reorganized by selecting items to fully reflect the intention of the researcher.

3.1 Bicycle driving under the influence

Bicycle DUI was checked by a question, "Having you ever ride a bicycle after drinking even a little over the past year?" If a subject checked "no," it was taken as no, and "yes," is classified as yes.

3.2 Personality factors

Personality factors included gender, age, residence place, education level, spouse, economic activity, and stress. Gender was classified as male and female, and age in five groups: (19-29 years, 30-39 years, 40-49 years,

50-59 years, and over 60 years of age). Residence place was classified into two groups: countryside (Eup and Myeon) and urban (Dong). Education level was classified into two groups: ≤ middle school graduate (elementary school graduate and middle school graduate) and ≥ high school graduate (high school graduate and over college graduate). Spouse was classified into two groups: no (separation, bereavement, divorce) and yes (living with a spouse). Economic activity was asked with a question, "Have you worked for more than one hour of the last week or more than 18 hours as an unpaid family worker?" Two groups were classified based on the answers: no ("no") and yes ("yes"). Stress was asked by a question, "How much do you feel stress in everyday life?" Three groups were classified based on the answers: no ("no" and "almost never felt"), less ("I feel a little"), and more ("I feel a lot").

3.3 Lifestyle habit factors

Lifestyle habit factors included smoking, strength exercise, aerobic physical activity, walking exercise. Smoking was asked with questions, "How many cigarettes have you smoked during your life?" and "Do you smoke now?" Three groups were classified based on the answers: no ("under 5 packs" and "never smoked"), past smoker ("smoking in the past, but not in the present"), current smoker ("over 5 packs", "daily smoked", and "sometime smoke"). Strength exercise was asked by a question, "In the last week, how many days did you do your strength exercises such as push-ups, sit-ups, dumbbells, weights, and iron bars?" Two groups were classified based on the answers: no ("don't exercise" and "1 day") and yes ("over 2 days"). Aerobic physical activity was classified into two groups: no (< 2h 30m of medium-intensity physical activity/week or < 2h 30m of high-intensity physical activity/week or no mixing of the high and medium-intensity activity) and yes (≥ 2h 30m of medium-intensity physical activity/week or ≥ 2h 30m of high-intensity physical activity/week or do mixing of the high and medium-intensity activity). In the aerobic physical activity, high-intensity physical activity defines as running, jumping rope, climbing, basketball, swimming, badminton, etc. and medium-intensity physical activity is fast walking, light running, weight training, golf, dance sports, pilots, etc. Walking exercise was classified into two groups: no (< 30 minutes and 5 days a week) and yes (≥ 30 minutes and 5 days a week).

3.4. Drinking habit factors

Drinking habit factors included the frequency of drinking, one-time drinking, the frequency of binge drinking. The frequency of drinking was asked with a question, "How often do you drink alcohol in the last year?" Four groups were classified based on the answers: ≤ 1 time/month ("no drink in the last year", "under once a month", and "once a month"), 2-4 times/month ("2-4 times a month"), 2-3 times/week ("2-3 times a week"), and ≥ 4 times/week ("over 4 times a week"). One-time drinking was asked by a question, "How much do you drinks at one time in the last year?" Three groups were classified based on the answers: ≤ 2 cups ("1-2 cups"), 3-6 cups ("3-4 cups" and "5-6 cups"), and ≥ 7 cups ("7-9 cups" and "10 cups"). The exact measuring unit of one cup is not specified as commonly distinguished by soju or hard liquor shot glass as 1 cup and a canned beer of 355cc calculated as 1.6 cups. The frequency of binge drinking was asked with a question, "How many times do you drink more than 7 cups (or about 5 cans of beer) in each cup, without distinction of soju and liquor in one drink?" Four groups were classified based on the answers: no ("not at all"), ≤ 1 time/month ("under once a month" and "once a month"), 1 time/week ("1 time a week"), and almost daily ("almost daily").

3.5. Safety awareness factors

Safety awareness factors included use a belt during driving, use a belt on the passenger seat, use a helmet during bicycling, vehicle DUI, and experience aboard a DUI vehicle. Use a belt during driving and use a belt on the passenger seat were classified into two groups: don't always use and always use. Use a helmet during bicycling was asked with a question, "How often have you used a helmet when bicycling in the last year?" Two groups were classified based on the answers: don't always use ("never wear", "rarely wear", "sometime wear", and "frequently wear") and always use (always use). Vehicle DUI was asked with a question, "Having you ever drive a car and motorbike after drinking even a little over the past year?" If a subject checked "no," it was taken as no, and "yes," is classified as yes. Experience aboard a DUI vehicle was asked with a question, "How many times have you been driving a car that someone drank a bit during the last year?" Three groups were classified based on the answers: no ("not at all"), 1-3 times ("1 time" and "2-3 times"), and ≥ 4 times ("4-5 times" and "over 6 times").

4. Data Collection

This study used the Seventh KNHANES (2016) data from KNHANES homepage. The data download procedure was as follows. First, enter user's e-mail, and second, download after registration and agreeing consents of user information on data user security certificate and user compliance statement.

The data from Seventh KNHANES (2016) used a two-step stratified multi-stage sampling method that represents the demographics of Korean people. The survey was conducted by trained investigators using structured questionnaire. Trained investigators conducted surveys in households and administered questionnaires to adults. Household surveys included the health survey, examination survey, and nutritional survey.

5. Data Analysis

The collected data used SPSS 22.0 program, the general characteristics of Korean adults analyzed for complex sample descriptive statistics. The difference in bicycle DUI according to Korean adults' general characteristics analyzed for complex sample Rao-Scott x^2-test. Also, the factors affecting bicycle DUI of Korean adults analyzed for complex sample multivariate logistic regression to variables that were statistically significant in a complex sample Rao-Scott x^2-test analysis.

6. Ethical Consideration

This study was conducted after receiving the deliberation and exemption (P01-201808-22-001) from the Bioethics Committee designated by the Ministry of Health and Welfare for the ethical protection of the participants. The KNHANES conducted without the deliberation by the institute review board was conducted for public welfare. The KNHANES data containing personal information such as age, number of households, household income, kind of health insurance, etc. were deleted to protect the identification information and sensitive information.

7. Results

7.1 The general characteristics of Korean adults

The general characteristics of Korean adults had experienced bicycle DUI is shown in Table 1. In personality factors, the majority were males (91.2%), and over 60 years of age was the majority (29.0%). Also, living in the urban (82.1%), over high school graduate (69.6%), live with a spouse (68.6%), engaged in economic activity (69.4%), and less stressful (59.0%) were the majority.

In lifestyle habit factors, non-smoker (38.5%), don't strength exercise (66.3%), do the aerobic physical activity (51.4%), and don't walk exercise (56.7%), were the majority.

In drinking habit factors, the frequency of drinking was 2-3 times/week (34.7%), one-time drinking was over 7 cups (52.5%), and the frequency of binge drinking was below 1 time/month for 38.4% were the majority.

In safety awareness factors, always use a belt during the drive (79.2%), always use a belt on the passenger seat (58.5%), don't always use a helmet during bicycling (93.1%), having no experience DUI (80.6%), and having no experience aboard a DUI vehicle (80.3%) were the majority.

Table 1. Differences in Bicycle Driving Under the Influence according to Participants' General Characteristics

| Characteristics | Categories | Prevalence of bicycle driving under the influence (%) | Bicycle driving under the influence | | Rao-Scott x^2 | *p* |
			Yes (n=147) $N^†$ (%)††	No (n=1150) $N^†$ (%)††		
Total		11.7	147(100.0)	1150(100.0)		
Personality factors						
Gender	Male	16.0	134(91.2)	695(63.6)	31.09	<.001
	Female	3.1	13(8.8)	455(36.4)		
Age (year)	≤29	9.7	15(19.3)	189(23.8)	1.73	.149
	30-39	11.3	20(16.5)	203(17.2)		
	40-49	9.6	25(18.3)	242(22.9)		
	50-59	11.0	20(16.9)	188(18.1)		

	≥60	17.6	67(29.0)	328(18.0)		
Residence place	Countryside	13.6	36(17.9)	245(15.1)	0.40	.528
	Urban	11.4	111(82.1)	905(84.9)		
Education level	≤Middle school	17.6	54(30.4)	297(19.2)	7.75	.006
	≥High school	10.4	91(69.6)	812(80.8)		
Spouse	No	10.6	34(31.4)	323(35.1)	0.43	.513
	Yes	12.3	113(68.6)	827(64.9)		
Economic activity	No	12.0	51(30.6)	360(30.3)	0.02	.962
	Yes	11.8	94(69.4)	749(69.7)		
Stress	No	13.6	30(16.3)	187(13.7)		
	Less	11.7	85(59.0)	666(59.2)	0.34	.700
	More	10.8	32(24.6)	296(27.0)		
Life habit factors						
Smoking	No	8.6	45(38.5)	620(53.8)		
	Past smoker	14.0	61(29.2)	300(23.8)	4.33	.014
	Current smoker	16.1	41(32.4)	230(22.4)		
Strength exercise	No	10.8	103(66.3)	833(73.8)	2.00	.159
	Yes	14.8	42(33.7)	275(26.2)		
Aerobic physical activity	No	12.7	72(48.6)	535(44.8)	0.67	.413
	Yes	11.2	73(51.4)	574(55.2)		
Walking exercise	No	11.8	73(56.7)	543(59.1)	0.17	.680
	Yes	12.8	47(43.3)	344(40.9)		
Drinking habit factors						
Frequency of drinking	≤1 time/month	3.2	11(10.3)	502(44.0)		
	2-4 times/month	13.7	38(31.5)	280(27.9)	20.84	<.001
	2-3 times/week	18.8	56(34.7)	209(21.1)		
	≥4 times/week	32.2	42(23.5)	76(7.0)		
One-time drinking (cup)	≤2	2.4	13(6.5)	455(37.6)		
	3-6	14.3	68(41.0)	353(34.6)	25.15	<.001
	≥7	21.0	66(52.5)	259(27.8)		
Frequency of binge drinking	No	4.6	17(9.1)	327(30.0)		
	≤1 time/month	12.9	50(38.4)	240(41.2)		
	1 time/week	20.2	50(33.7)	173(21.2)	10.07	<.001
	Almost daily	28.2	28(18.7)	66(7.5)		
Safety awareness factors						
Use a belt during driving	Don't always use	11.1	27(20.8)	182(22.5)	0.15	.697
	Always use	12.2	74(79.2)	587(77.5)		
Use a belt on the passenger seat	Don't always use	13.7	59(41.5)	352(33.8)	2.74	.100
	Always use	10.3	83(58.5)	766(66.2)		
Use a helmet during bicycling	Don't always use	12.4	134(93.1)	1012(87.5)	4.56	.034
	Always use	6.8	13(6.9)	138(12.5)		
Vehicle driving under the influence	No	10.7	81(80.6)	695(93.5)	15.72	<.001
	Yes	29.2	25(19.4)	57(6.5)		
Experience aboard a driving under the influence vehicle	No	10.9	116(80.3)	1013(87.1)		
	1-3	15.8	25(15.9)	119(11.2)	2.40	.093
	≥4	22.9	6(3.8)	18(1.7)		

†Unweighted, ††Weighted

7.2 The difference of bicycle DUI according to Korean adults' general characteristics

The prevalence of bicycle DUI was 11.7% among Korean adults. The prevalence of bicycle DUI indicated statistically significant difference in gender, education, smoking, the frequency of drinking, one-time drinking, the frequency of binge drinking, use a helmet during bicycling, and vehicle driving under the influence ($p<.05$) (Table 1).

In personality factors, the prevalence of bicycle DUI was higher in males than females (16.0% vs. 3.1%, $p<.001$), and over 60 years of age was the highest, but not statistically

significant (17.6%, $p=.149$). The prevalence of residence place was higher in countryside than urban (13.6% vs. 11.4%, $p=.528$), higher for below middle school graduate than over high school graduate (17.6% vs. 10.4%,

p=.006). Also, living with a spouse (12.3%, p=.513), don't economic activity (12.0%, p=.962), and no stress (13.6%, p=.700) were the higher, but not statistically significant.

In lifestyle habit factors, the prevalence of bicycle DUI was highest for current smoker than non-smoker and past smoker (16.1% vs. 8.6% vs. 14.0%, p=.014, respectively). Also, doing strength exercise (14.8%, p=.159), doing aerobic physical activity (12.7%, p=.413), and don't walk exercise (12.8%, p=.680) were the highest, but not statistically significant.

In drinking habit factors, the higher the frequency of drinking increased the prevalence of bicycle DUI (p<.001), as follows: 32.3% ($\geq$ 4 times/week), 18.8% (2-3 times/week), 13.7% (2-4 times/month), and 3.2% ($\leq$ 1 time/month). The higher the one-time drinking increased the prevalence of bicycle DUI (p<.001), as follows: 21.0% ($\geq$ 7 cups), 14.3% (3-6 cups), and 2.4% ($\leq$ 2 cups). Also, with the increased frequency of binge drinking, the prevalence of bicycle DUI (p<.001) increased, as follows: 28.2% (almost daily), 20.2% ($\leq$ 1 time/month), 13.7% (2-4 times/month), and 3.2% (no).

In safety awareness factors, the prevalence of use a belt during driving was higher for always use than don't always use (11.1% vs. 12.2%, p=.697), and use a belt on the passenger seat was higher for don't always use than always use (13.7% vs. 10.3%, p=.100), but not statistically significant. The prevalence of use a helmet during bicycling was higher for don't always use than always use (12.4% vs. 6.8%, p=.034), and the vehicle DUI was higher for yes than no (29.2% vs. 10.7%, p<.001). Also, the experience aboard a DUI vehicle was higher for over 4 times than no and 1-3 times, but not statistically significant (22.9% vs. 15.8% vs. 10.9%, p=.093, respectively).

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significant (17.6%, p=.149). The prevalence of residence place was higher in countryside than urban (13.6% vs. 11.4%, p=.528), higher for below middle school graduate than over high school graduate (17.6% vs. 10.4%, p=.006). Also, living with a spouse (12.3%, p=.513), don't economic activity (12.0%, p=.962), and no stress (13.6%, p=.700) were the higher, but not statistically significant.

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7.3 The impact factors of bicycle DUI

In the multivariate logistic regression analysis, gender, education level, smoking, the frequency of drinking, one-time drinking, the frequency of binge drinking, DUI, and experience aboard a DUI vehicle were found to be significantly related to a higher odds of bicycle DUI (Table 2). The odds ratio of bicycle DUI showed males was 4.53 times higher than females (95% CI=1.36-15.10, p=.014), and below middle school graduate was 2.34 times higher than over high school graduate (95% CI=1.16-4.66, p=.016). The frequency of drinking showed that as participants' frequency of drinking increased, so as the odds ratio, as follows: over 4 times/week (OR=7.92, 95% CI=1.16-4.66, p=.004), 2-3 times/week (OR=6.12, 95% CI=1.75-21.41, p=.005), 2-4 times/month (OR=4.07, 95% CI=1.20-13.85, p=.025). The odds ratio of one-time drinking showed over 7 cups was 5.54 times higher than below 2 cups (95% CI=1.21-25.36, p=.026), and the odds ratio of DUI showed yes was 2.11 times higher than no (95% CI=1.09-4.07, p=.026).

Table 2. Multivariate Logistic Regression of Factors Influencing Bicycle Driving Under the Influence

Variables	Categories	Bicycle driving under the influence (n=147)	
		OR§ (95% CI‖)	*P*
Gender	Male	4.53(1.36-15.10)	.014
	Female	1.00	
Education level	≤Middle school	2.34(1.16-4.66)	.016
	≥High school	1.00	
Frequency of drinking	≥4 times/week	7.92(1.97-31.87)	.004
	2-3 times/week	6.12(1.75-21.41)	.005
	2-4 times/month	4.07(1.20-13.85)	.025
	≤1 time/month	1.00	
One-time drinking (cup)	≥7	5.54(1.21-25.36)	.028
	3-6	3.40(0.85-13.71)	.085
	≤2	1.00	
Vehicle driving under the influence	Yes	2.11(1.09-4.07)	.026
	No	1.00	

§ OR=Odds ratio, ‖CI=Confidence interval

8. Discussion

This paper is to verify, the relevance to bicycle helmet use and bicycle DUI, and the factors affecting bicycle DUI of the Korean adults over 19 years of age using data from the Seventh Korea National Health and Nutrition Examination Survey (KNHANES, 2016). The notable results are as follow.

First, the prevalence of bicycle DUI was 11.7% among Korean adults. Such a result was similar to the result of Hwang et al.'s study [11] that used the Fifth KNHANES (2010-2012) data, in which showed the prevalence of bicycle DUI in Korean adults over 19 years of age was 12.1%. The Chae & Lee's study [13] used the same data as this paper and demonstrated the prevalence of vehicle DUI was 7.8%, and through the result, they verified that the incidences of bicycle DUI is higher than vehicle DUI. From these results, it surmises that the misperception of people who think bicycle DUI is safer than vehicle DUI [11] and that the current institutional system to respond the bicycle DUI is insufficient [1] are related to the social significance of the issues regarding bicycle DUI. Therefore, facilitating education and promotion, and establishing systems for the culture of safe bicycle use is necessary to change the safety awareness of the bicycle riders.

Second, the prevalence of bicycle DUI of Korean adults was indicated with statistically significant difference according to gender and education among the personality factors. In this paper, the prevalence of bicycle DUI according to gender was 16.0% in males and 3.1% in females, and the odds of bicycle DUI showed males was 4.53 times higher than females. Such a result was similar to the study [11] showed the prevalence of bicycle DUI for males was 4.01 times higher than females. Males were drinking more, thus, are more likely to lose self-control and a lack of awareness of social sanctions while drinking [16], and in the bicycle traffic accidents current status report, the component ratio of perpetrator and victim on males was 3 to 5 times higher than females [3]. From these results, I can infer the relation of bicycle DUI to males drinking much, more likely to loss of self-control, and high bicycle utilization. Therefore, the establishment of appropriate drinking habits is essential to prevent bicycle DUI.

The prevalence of bicycle DUI according to education level was 17.6% in below the middle school graduation and 10.4% in over high school graduation, and the odds ratio of bicycle DUI showed below middle school graduation was 2.34 times higher than over high school graduation. Such a result was similar to the study [11] showed the experience of bicycle DUI of adults below middle school graduation was 66.2%. The bicycle DUI is related to the vehicle [11, 12], so the researcher examined the prior studies on the vehicle. The result of Jekarl et al. 's study [17] used the Forth KNHANES (2007-2009) data, in which showed the prevalence of vehicle DUI in Korean adults over 19 years of age was higher in below middle school graduate. Through this, I can surmise the relevance of the lower the level of education, the lower the perceived to the risk of DUI. Also, this paper and the study of Hwang et al. [11] illustrated the relevance of the high DUI experience of adults over 60 years of age and living in the countryside. From these results, the high experience of bicycle DUI is inferred to be relevant that the relatively less opportunity for educational benefit has adults over 60 years of age and adult living in the countryside. Therefore, carrying out the bicycle safety education and campaigns on the national level for the bicycle riders in the country, is necessary to change the perception of bicycle DUI.

Third, the prevalence of bicycle DUI of Korean adults was a statistically significant difference according to smoking among the lifestyle habit factors. In this paper, the prevalence of bicycle DUI was showing the 16.1% in a current smoker, 8.6% in a non-smoker, and 14.0% in a past smoker, and a current smoker was the highest. Such a result was similar to the study [11] showed the experience of bicycle DUI of the smoker was 66.2%. These results were consistent with the results of the study that smoking habits were a significant impact on bicycle DUI [18], and the smoking was verified as a factor affecting bicycle DUI. Also, this paper showed the statistically significant difference between past smoker and non-smoker. It is derived because the non-smoking period is an exclusion in past smoking variable. Therefore, it is necessary to reiterate a study verifying the relevance of smoking and bicycle DUI in consideration of the non-smoking period.

Fourth, the prevalence of bicycle DUI of Korean adults indicated a statistically significant difference according to the frequency of drinking, one-time drinking, and the frequency of binge drinking among the drinking habit factors. In this paper, the higher the frequency of drinking, one-time drinking, and the frequency of binge drinking were factors related to the prevalence of bicycle DUI. Among them, the frequency of drinking and one-time drinking were verified as factors affecting the bicycle DUI. Also, the odds of bicycle DUI showed the frequency of drinking was that over 4 times of week was 7.61 times, 2-3 times of week was 5.78 times, and 2-4 times of month was 3.93 times, higher than below once a month, and the odds showed one-time drinking was higher 5.54 times in over 7 cups than below 2 cups. Such results were similar to the study [11] that showed that the higher the score of alcohol use disorder identification test (AUDIT) the prevalence of bicycle DUI increased. From these results, it verified, that the more the alcohol use disorder with a high frequency of drinking, the adult with great one-time drinking and high frequency of binge, the prevalence of bicycle DUI increased. Moreover, another study showed that drivers with the alcohol use disorder were more likely to have DUI experience than the drivers without such experience [17], so drivers with the alcohol use disorder are surmised to be exposed to all types of DUI. Therefore, providing education on healthy drinking guideline and abuse of alcohol by excessive drinking to bicyclist with high-risk drinking habits in connection with the public health center, if necessary. Establishment of an appropriate drinking habits is thought to be the primary method to prevent bicycle DUI as well as vehicle DUI.

Fifth, the prevalence of bicycle DUI of Korean adults indicated a statistically significant difference according to use of a helmet while riding bicycles and DUI among the safety awareness factors. In this paper, the prevalence of bicycle DUI according to bicycle helmet use was 12.4% in always don't use a helmet and 6.8% in always do use a helmet, and in the case of the always don't use a helmet was showed higher than the always do use a helmet. Such results were similar to the study results of Harada et al. [14] for bicycle accident patients in America, about 95.3% were drunk riders that did not use bicycle helmets. Through these results, I identify the relation between bicycle helmet use and safety awareness. Adults with low safety awareness may be are more likely to be involved in drunk driving. Moreover, the result in this paper showed the poor rate of using a bicycle helmet of Korean adults allows us to hypothesize the lack of awareness of the importance of using a bicycle helmet of Korean adults and that the culture of safe bicycle use is not established yet. The results of this study are significant as they were not found in prior studies conducted in Korea and are necessary to reiterate further studies verifying the relevance of using a bicycle helmet and bicycle DUI. To examine another study provided an analysis of emergency medical data of the highest bicycle accident injury, head injury was 38.4% [19]. Bicycle DUI riders not using a bicycle helmet had 3.23 times higher chance to have head injury than other cases [10]. Therefore, bicycle riders should recognize that it is the riders' obligation to use bicycle helmets, and it is necessary for the societal promotion through social networks or mass media to establish the culture of bicycle helmets use. Also, a system to impose a fine on riders who do not use bicycle helmets is necessary to be established and enforced.

The prevalence of bicycle DUI according to DUI was 10.7% in having no experience of DUI and 29.2% in having experience DUI, and the odds of bicycle DUI showed having experienced DUI was 2.11 times higher than having no experience of DUI. Such a result was similar to the study [11] showed that the prevalence of bicycle DUI of having no experience of DUI was 8.4% and having experience DUI was 27.2%. Also, examining another study, adults having experience of bicycle DUI were 2.55 times more likely to be in odds to experience DUI. From these results, I verified that bicycle DUI and vehicle DUI are mutually influential factors, and it proved that it would be bicycle DUI that leads to DUI and DUI that leads to bicycle DUI. Therefore, education and raising publicity on the national level will be needed to recognize that bicycle DUI and DUI are mutually related, thus, carry out mutual transition.

9. Conclusions

This paper has verified the relevance of bicycle helmet use, bicycle DUI, and the factors affecting bicycle DUI among Korean adults over 19 years of age. The significance of this study would be that it revealed the number of adult riders not using bicycle helmets were higher than the examined prevalence of bicycle DUI and that the bicycle DUI and DUI are mutually related and can bring mutual transition. In this paper, the factors affecting bicycle DUI were verified as gender, education, the frequency of drinking, one-time drinking, and experience aboard a DUI vehicle.

In conclusion, to prevent bicycle DUI among Korean Adults, we would need to facilitate appropriate drinking habits, provide treatments for disorders related to alcohol use, and change the social perception of bicycle DUI. Also, we should promote the establishment of the culture of bicycle helmet use, the establishment of a system that imposes fine to non-helmet-using riders, and education and publicity on the national level to recognize that bicycle DUI and DUI are mutually related, thus, can carry out mutual transition.

9.1 Suggestions

Suggestions for future research are as follows. First, further study is necessary to verify the frequency of bicycle use in daily routines, subject norms, attitude toward bicycle DUI, and relevance of bicycle DUI to those factors. Second, an iterative study should be conducted to verify the factors affecting bicycle DUI. Third, further study is necessary to verify the factors affecting bicycle helmet use.

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