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Is motorcycle use associated with unhealthy lifestyles? Findings from Taiwan

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ABSTRACT

Introduction: In addition to driving, using a motorcycle is a common mode of sedentary transportation in Asian countries, but its associations with lifestyle behaviors remain unknown. The present study aimed to examine the associations of motorcycle use time with lifestyle behaviors in a sample of Taiwanese urban adults.

Methods: A cross-sectional survey was administered to Taiwanese urban adults aged 20–64 years. Data on time spent in motorcycle use (none: 0, low: 1–209, high: 210 + min/week), lifestyle behaviors, and sociodemographic characteristics were acquired from 1069 adults in three urban cities. Unadjusted and adjusted logistic regression analysis were used.

Results: After adjusting for potential covariates, adults who spent at least 30 min a day on motorcycles were less likely to have sufficient levels of active transportation (odds ratio [OR] = 0.44; 95% confidence intervals [CI]: 0.31–0.62) and less likely to drink alcohol (OR = 0.53; 95% CI: 0.31–0.90) than those who did not. No significant associations of motorcycle use with leisure-time physical activity, sitting time, sleep, current smoking status, and dietary behavior were observed.

Conclusions: Motorcycle use is a potential behavioral risk factor for active mode of transportation. Future lifestyle interventions and transportation-related policies may consider reducing motorcycle use time as a possible strategy for health promotion.

1. Introduction

In modern society, using motorized vehicles to travel to work and other destinations is a habitual sedentary behavior with known deleterious health impacts (Bauman et al., 2011). Among different modes of sedentary transportation, a number of studies have reported that more time spent in car is associated with increased risk of obesity (Frank et al., 2004), weight gain (Sugiyama et al., 2013), and cardiovascular disease mortality (Warren et al., 2010). Since recent research focus has shifted to the impact of driving as a health-related behavior, driving has also been found to be related to unhealthy lifestyle behaviors (i.e., smoking, insufficient physical activity, and short sleep) and worse physical and mental health (Ding et al., 2014). However, studies on this issue have only focused on

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car use and mostly report on Western countries, which are characterized as car-oriented countries.

Based on different cultural, economic, and environmental contexts, motorcycle riding is a more common mode of sedentary transportation in a number of Asian countries (World Health Organization, 2015). Like car use, motorcycle use is an unsustainable mode with a negative impact on the environment and reduces opportunities for active transportation or safe outdoor activity (Lyons and Chatterjee, 2008). Moreover, compared with car drivers, motorcyclists also have higher risks of road traffic deaths and air pollution exposure (World Health Organization, 2015). In addition to these negative health impacts, it remains unclear whether motorcycle use is a health-related behavior like driving. To strengthen the evidence base, Taiwan offers a unique research opportunity in this context. Taiwan has a particularly high rate of motorcycle ownership (58.2 per 100 people in 2015, consistent over the past two years), and nearly half of Taiwan's adult population (49.6%) uses motorcycles as their main mode of transportation (Ministry of Transportation and Communication of Taiwan, 2014). Since motorcycle use has been found to be associated with higher risks of being overweight in adults (Lin et al., 2017), it is of value to further understand the association of motorcycle use with health behaviors to yield critical information for public health initiatives, especially in motorcycle-oriented countries. It was hypothesized that longer exposure to motorcycle riding is associated with greater likelihood of engaging in unhealthy lifestyle behaviors. Thus, the aim of the present study was to examine the associations between time spent in motorcycle use and a series of lifestyle behaviors (active transportation, leisure-time physical activity, sitting time, sleep, alcohol use, current smoking status, and dietary behavior) in the sample of Taiwanese urban adults.

2. Material and methods

2.1. Patient and public involvement

A cross-sectional survey was executed via telephone in three urban cities of Taiwan (Taipei City, New Taipei City, and Kaohsiung City) from September to October of 2015. Detailed information about these three cities have been previously reported (Liao, 2016). We used stratified random sampling to recruit the participants in this survey. We stratified the participants by age (20–29, 30–39, 40–49, 50–59, and 60–64 years) and gender in different cities individually. Telephone numbers were selected by a computer-assisted telephone interviewing system. Each interviewer was trained to use a standardized questionnaire to interview, controlled the length of each interview to less than 20 min, and had experience conducting a telephone-based survey. After a total of 5333 adults were contacted and our data were cleaned, 1003 of them completed the survey without any missing information (response rate: 20.04%). Participants were asked for verbal informed consent before each telephone interview started and were offered no reward. The study protocols were approved by the Research Ethics Committee (REC) of National Taiwan Normal University (REC number: 201504HM005).

2.2. Outcome variables

Lifestyle behaviors in the present study included the following seven variables: active transportation, leisure-time physical activity, sitting time, sleep, alcohol use, current smoking status, and dietary behavior.

2.2.1. Active transportation, leisure-time physical activity, and sitting time

Active transportation and leisure-time physical activity were measured by the Taiwanese version of the International Physical Activity Questionnaire-Long Version (IPAQ-LV). High test–retest reliability ($r = 0.78$) and content validity (intraclass correlation coefficient [ICC] = 0.99) of the questionnaire have been confirmed (Liou et al., 2008). Active transportation was measured for frequency (number of days in the last 7 days) and duration (minutes/day) of "walking" and "cycling" for transportation. The sum of time spent in active transportation was calculated by multiplying frequency of transportation per week by duration of transportation per day. Leisure-time physical activity was measured for frequency (number of days in the last 7 days) and duration (minutes/day) of moderate-intensity physical activity, vigorous-intensity physical activity, and leisure-time walking. We calculated leisure-time physical activity by multiplying the frequency per week of moderate-intensity physical activity, vigorous-intensity physical activity, and leisure-time walking by the duration of each variable per day. Based on the recommendation for physical activity and health for adults (Haskell et al., 2007), total time spent in active transportation and leisure-time physical activity was dichotomized as sufficient ($\geq$150 min/week) and insufficient ($<$150 min/week).

Sitting time was assessed using a Taiwanese version of the IPAQ-Short Version. The content validity (ICC = 0.99) and the indices for language equivalence and meaning similarity between the English and Chinese versions was 0.99 (Liou et al., 2008). Participants were asked, "During the last 7 days, how much time did you usually spend sitting on a weekday?" For the purpose to demonstrate the habitual behavior, we used the word "weekday" for the IPAQ-Short Version, which has been utilized in epidemiology surveys of sitting behavior (Bauman et al., 2011). Excessive sitting time was defined as sitting more than 8 h/day based on previous findings (van der Ploeg et al., 2012). Therefore, sitting time was divided into "High" (sitting 8 + hours/day) and "Low" (sitting not exceeding 8 h/day).

2.2.2. Sleep

Participants were asked, "How many hours do you sleep on an average day?" The duration of sleep was categorized as "at risk" (sleep duration less than 7 or more than 9 h/day), and "not at risk" (sleep duration between 7 and 9 h/day), which was reported in previous research (Cappuccio et al., 2010, 2011).

2.2.3. Alcohol use, current smoking status, and dietary behavior

Lifestyle behaviors including alcohol use, current smoking status, and dietary assumption were also recorded. The total number of alcoholic drinks they consumed each week were obtained, and participants were categorized into "Yes" and "No." Participants were also required to answer whether they were current smokers (divided into "Yes" and "No") and how many fruits and vegetables they consumed on an average day. Taiwanese dietary guidelines for fruit and vegetable consumption were used as a standard to identify risk of dietary behavior (Health Promotion Administration and Ministry of Health and Welfare, 2017). The total number of fruit and vegetable servings they consumed on an average day were divided into "Yes" (meeting the dietary guideline) and "No" (not meeting the dietary guideline).

2.3. Independent variables

Self-reported motorcycle use (both riders and passengers were included) assessed by the question from the IPAQ-LV (Liou et al., 2008). First of all, the participants were asked the number of days traveling on a motorcycle during the last 7 days. Then, they were asked, "How much time did you usually spend on one of those days traveling on a motorcycle?" The sum of time spent in motorcycle use was calculated by multiplying frequency (number of days in the last 7 days) by duration of motorcycle use (minutes/day). The participants were categorized into tertiles based on the skew distribution of time spent in motorcycle use—none (0 min/week), low (1–209 min/week), and high (≥210 min/week).

2.4. Covariates

The covariates were sociodemographic variables, namely, gender, age, residential city, education level, occupation type, marital status, living status, body mass index (BMI), and motorcycle ownership. We divided age into five categories based on 10-year age-bands: 20–29, 30–39, 40–49, 50–59, and 60–64 years. Education level was classified into two sections: "high school degree or lower" and "university degree or higher." Occupation type was divided into "not full-time job" and "full-time job." Marital status was classified into "married" and "not married" (including single, separated, divorced, and widowed). Living status was divided into "living with others" and "living alone." BMI was calculated from self-reported height and weight (calculated as weight in kilograms divided by the square of height in meters) and dichotomized into non-overweight (<24 kg/m^2) and overweight (including obese, ≥24 kg/m^2).

Table 1
Basic characteristics of participants with time spent in motorcycle use (n = 1069).

	Time spent in motorcycle use				
	Total (%)	None (0 min)	Low (1–209 min)	High (≥210 min)	P-Value
N (%)	1069	401 (37.5%)	295 (27.6%)	373 (34.9%)	
Gender					<0.001**
Male	49.2%	42.1%	49.5%	56.6%	
Female	50.8%	57.9%	50.5%	43.4%	
Age (year)					0.001*
20–29	13.1%	13.2%	7.8%	17.2%	
30–39	21.7%	19.0%	22.4%	24.1%	
40–49	24.4%	20.9%	28.1%	25.2%	
50–59	27.0%	31.4%	25.8%	23.3%	
60–64	13.8%	15.5%	15.9%	10.2%	
Residential city					<0.001**
Taipei City	33.0%	47.9%	25.1%	23.3%	
New Taipei City	34.1%	34.9%	36.3%	31.4%	
Kaohsiung City	32.9%	17.2%	38.6%	45.3%	
Educational level					0.034*
High school and lower	38.2%	33.4%	42.7%	39.7%	
University and higher	61.8%	66.6%	57.3%	60.3%	
Occupational type					0.076
Not full-time job	31.2%	34.9%	31.2%	27.3%	
Full-time job	68.8%	65.1%	68.8%	72.7%	
Marital status					0.014*
Not married	32.8%	31.2%	28.1%	38.3%	
Married	67.2%	68.8%	71.9%	61.7%	
Living status					0.865
Living alone	4.9%	4.7%	5.4%	4.6%	
Not living alone	95.1%	95.3%	94.6%	95.4%	
BMI					0.049*
Non-overweight	59.9%	64.3%	59.0%	55.8%	
Overweight	40.1%	35.7%	41.0%	44.2%	
Motorcycle ownership					<0.001**
No	13.2%	34.7%	0.3%	0.3%	
One or more	86.8%	65.3%	99.7%	99.7%	

*$p < 0.05$, **$p < 0.001$.

Motorcycle ownership was divided into "one or more" and "none."

2.5. Data analysis

Data from 1069 Taiwanese urban adults who contributed complete information for the study variables were analyzed. Logistic regression analyses were conducted for each health-related behavior variable before and after adjustment for gender, age, residential city, education level, occupation type, marital status, living status, BMI, and motorcycle ownership. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated for each variable. Inferential statistics were performed using IBM SPSS 22.0, and the level of significance was set at $p < 0.05$.

3. Results

3.1. Participants' basic characteristics

Table 1 presents the demographic characteristics of the sample of Taiwanese urban adults. Among the participants, their mean age was 45.1 years (standard deviation [SD] = 12.2), 49.2% were male, 33.0% lived in Taipei City, 61.8% had a university degree or higher, 68.8% had a full-time job, 67.2% were married, 95.1% were not living alone, 59.9% were non-overweight, and 86.8% owned one or more motorcycles. The mean time engaging in motorcycle use was 183.4 min/week (SD = 267.6). Adults who used motorcycle tended to be male, be 40–49 years old, live in Kaohsiung City, have a university degree or higher, be married, be non-overweight, and own at least one motorcycle.

We demonstrated the associations between seven lifestyle factors and the time spent in motorcycle use in Table 2. In the sample of Taiwanese urban adults, participants had relatively healthy lifestyle behaviors. More than half of the participants had sufficient active transportation (69.0%), had low sitting time (64.1%), had an appropriate sleep duration (62.1%), did not drink (89.5%), did not smoke (86.8%), and had a balanced diet (73.7%); by contrast, only 44.8% had sufficient leisure-time physical activity. Adults who spent more time in motorcycle use were more likely to have insufficient active transportation and did not smoke.

3.2. Motorcycle use associated with lifestyle factors

We showed the associations between the unhealthy lifestyle factors and the time spent in motorcycle use (Table 3). Logistic regression analysis of the unadjusted model (Model 1) showed that the time spent in motorcycle use, both in Low (1–209 min/week) and High (≥210 min/week) groups, was significantly associated with active transportation and current smoking status. Participants who spent more time in motorcycle use were less likely to have sufficient transportation (Low group: OR = 0.55, 95% CI = 0.39–0.78; High group: OR = 0.34, 95% CI = 0.24–0.46) and more likely to be current smokers (Low group: OR = 1.76, 95% CI = 1.12–2.77; High group: OR = 1.61, 95% CI = 1.04–2.49). After adjusting for potential covariates in Model 2, we found that participants who spent more time in motorcycle use were less likely to have sufficient transportation. The results were only statistically significant in the High group

Table 2
Associations between lifestyle factors and time spent in motorcycle use among the participants (n = 1069).

	Time spent in motorcycle use				
	Total (%)	None (0 min)	Low (1–209 min)	High (≥210 min)	P-Value
N (%)	1069	401 (37.5%)	295 (27.6%)	373 (34.9%)	
Active transportation					<0.001*
Sufficient	69.0%	80.0%	68.8%	57.4%	
Insufficient	31.0%	20.0%	31.2%	42.6%	
Leisure-time physical activity					0.302
Sufficient	44.8%	44.1%	48.5%	42.6%	
Insufficient	55.2%	55.9%	51.5%	57.4%	
Sitting time					0.965
High	35.9%	36.2%	36.3%	35.4%	
Low	64.1%	63.8%	63.7%	64.6%	
Sleep					0.598
Not at risk	62.1%	60.3%	64.1%	62.5%	
At risk	37.9%	39.7%	35.9%	37.5%	
Alcohol use					0.12
Yes	10.5%	10.5%	13.2%	8.3%	
No	89.5%	89.5%	86.8%	91.7%	
Current smoking status					0.031*
Yes	13.2%	9.7%	15.9%	14.7%	
No	86.8%	90.3%	84.1%	85.3%	
Dietary behavior					0.54
Yes	73.7%	74.1%	75.6%	71.8%	
No	26.3%	25.9%	24.4%	28.2%	

*$p < 0.05$.

Table 3
Unadjusted and adjusted ORs for the association between motorcycle use time and lifestyle behaviors among the participants.

Model 1			
Motorcycle use time			
	None: 0 min/week ORs (95% CI)	Low: 1–209 min/week ORs (95% CI)	High: ≥210 min/week ORs (95% CI)
Lifestyle Factors			
Active transportation	1.00 (ref.)	0.55 (0.39–0.78)*	0.34 (0.24–0.46)**
Leisure-time physical activity	1.00 (ref.)	1.19 (0.88–1.60)	0.94 (0.71–1.25)
Sitting time	1.00 (ref.)	1.00 (0.73–1.36)	1.03 (0.77–1.39)
Sleep	1.00 (ref.)	1.17 (0.86–1.60)	1.09 (0.82–1.46)
Alcohol use	1.00 (ref.)	1.30 (0.82–2.07)	0.78 (0.48–1.26)
Current smoking status	1.00 (ref.)	1.76 (1.12–2.77)*	1.61 (1.04–2.49)*
Dietary behavior	1.00 (ref.)	1.09 (0.77–1.54)	0.89 (0.65–1.23)
Model 2 Motorcycle use time			
	None: 0 min/week ORs (95% CI)	Low: 1–209 min/week ORs (95% CI)	High: ≥210 min/week ORs (95% CI)
Lifestyle Factors			
Active transportation	1.00 (ref.)	0.70 (0.48–1.00)	0.44 (0.31–0.62)**
Leisure-time physical activity	1.00 (ref.)	1.32 (0.96–1.82)	1.09 (0.80–1.48)
Sitting time	1.00 (ref.)	1.01 (0.73–1.40)	1.14 (0.83–1.56)
Sleep	1.00 (ref.)	1.19 (0.86–1.64)	1.05 (0.77–1.44)
Alcohol use	1.00 (ref.)	1.08 (0.65–1.77)	0.53 (0.31–0.90)*
Current smoking status	1.00 (ref.)	1.37 (0.82–2.29)	1.02 (0.62–1.68)
Dietary behavior	1.00 (ref.)	1.09 (0.76–1.56)	0.97 (0.69–1.37)

*$p < 0.05$, **$p < 0.001$.
ORs = odds ratios; CI = confidence interval.
Model 2 adjusted for gender, age, residential city, education level, occupation type, marital status, living status, BMI, and motorcycle ownership.

(OR = 0.44, 95% CI = 0.31–0.62), but a similar trend occurred in the Low group (OR = 0.70, 95% CI = 0.48–1.00, p = 0.051). In addition, after adjusting for the covariates, we found that participants who spent excessive time (≥210 min/week) in motorcycle use were less likely to use alcohol (OR = 0.53, 95% CI = 0.31–0.90).

4. Discussion

This study is the first to examine the associations of motorcycle riding time with seven healthy lifestyle behaviors among adults in a context of a motorcycle-oriented country. The main finding of this study is that adults who spent at least 30 min per day on motorcycles were less likely to engage in active transportation in a sufficient level and also less likely to drink alcohol. No significant associations were observed with other health behaviors (i.e., leisure-time physical activity, sitting time, sleep, current smoking status, and dietary behavior such as fruit and vegetable consumption). These results may inform policymakers or intervention designers of motorcycle-oriented countries to consider developing effective strategies tailored to reduce motorcycle use for promoting active transportation in adults.

Although motorized vehicles may offer the opportunity to go for walks or cycle in pleasant environments (i.e., public open spaces) and to travel to places for physical activity (i.e., the gym, recreational facilities) (Mackett et al., 2011), previous studies have consistently found that use of motorized vehicles is associated with insufficient physical activity (Ding et al., 2014; Lopez-Zetina et al., 2006). However, these previous studies are limited to stratifying overall physical activity into the context of transportation and leisure time. Our results show that motorcycle use is negatively related to transportation physical activity, but has no significant associations with engagement in physical activity during leisure time. This result may indicate that motorcycle use could replace a number of bouts of time spent on the opportunity for active transportation, such as walking/cycling to work or for daily errands, and that motorcycle use may not be related to engagement in leisure-time physical activity. The present result can also partly explain a previous finding that more motorcycle use is associated with higher risks of overweight in adults (Lin et al., 2017). Moreover, evidence shows that effective strategies such as shift from motorized transport to active or public transport mode can contribute to more daily steps and transport-related physical activity and could reduce obesity in adults (Flint et al., 2016; Liao et al., 2016; Morency et al., 2011). Thus, promoting non-motorized transport such as motorcycle use in adults may increase physical activity during transport in daily life and potentially influence a large proportion of the population over time, thus having a significant public health impact (Saelens et al., 2003).

Firstly, inconsistent with a previous study (Ding et al., 2014), negative association between motorcycle use and alcohol use was observed in this study. This could be explained by the risk associated with riding a motorcycle under the influence of alcohol as well as strict laws against drunk driving in motor vehicles in Taiwan. Furthermore, inconsistent with a previous study reporting that driving is a health-related behavior (Ding et al., 2014), the present results show that motorcycle use is not be associated with a number of health behaviors (i.e., sitting time, sleep, current smoking status, and dietary behavior) except for active transportation and alcohol use. The differences could be explained by different purposes and characteristics between using a car and a motorcycle. Compared with cars,

motorcycles are purposed for use for short to middle-distance commuting or transportation such as work, shopping, or from place to place. The relatively shorter sedentary time on motorcycle may not contribute to overall sitting time. Moreover, previous studies have reported the association between long commutes and sleep deprivation (Christian, 2012; Costa et al., 1988). It is possible the shorter commuting time via motorcycle might not be related to sleeping problems in adults. Secondly, although the positive association between driving and smoking has been found, and it is possibly because smoking could be a reaction to driving-induced stress or time to kill in cars (Ding et al., 2014), no association was found between motorcycle use and smoking in the present study. It can be speculated that riding a motorcycle requires maintaining balance while riding or stepping, which may not make it easy for motorcyclists to smoke for the purpose of killing time or coping with traffic-related stress. Finally, no significant association between motorcycle use and dietary behavior could be interpreted by the measures of dietary behavior (focusing on fruit and vegetable consumption), but other dietary outcomes such as coffee, snacks, energy drinks, and sweetened beverages were not addressed. It is possible that using a motorcycle gives more access to the food environment. Future studies should use measures such as total energy intake, fast food intake, dining out, and energy from purchased foods to further identify these associations.

Several limitations of the present study should be considered. Due to the cross-sectional design, causality could not be decisive in this study, and the main measurements were self-reported and could be subject to bias. Furthermore, the respondents in the current study were more educated and had a higher prevalence of overweight. Therefore, results of the current study may be less germane and relevant to the general population. Finally, this study also had a limited representative sample because that it was asked via telephone; as a result, those without a household telephone (approximately 7.3% in 2016) were unable to reach (Directorate General of Bu, 2016).

5. Conclusions

Motorcycle use is a potential behavioral risk factor for active mode of transportation. Future lifestyle interventions and transportation-related policies may consider reducing motorcycle use time as a possible strategy for health promotion.

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Declarations of interest

The authors declare that they have no conflicts of interest.

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