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Barriers and facilitators of helmet use in a Greek sample of motorcycle riders: Which evidence?

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ABSTRACT

Aim: The current study aimed to assess the frequency of helmet use in a sample of Greek motorcycle riders as well as identify factors affecting self-reported helmet use including the riders' motivations and various socio-demographic, environmental and trip-related characteristics.
Method: A probabilistic, stratified random sampling was performed to select 405 riders aged 19–65 years from three cities of Crete. Data were collected through an easy-to-use self-administered questionnaire during face-to-face contacts with the study participants.
Results: The overall self-reported helmet use was very low. Gender, years of education, consumption of high concentrated alcohol, and time of day when riding occurred, were significant predictors of the frequency of self-reported helmet use. High agreement with the factors of *Imitation* ($B = 5.4$, $p < .001$), *Experience* ($B = 2.6$, $p = .001$), *Self-protection* ($B = 3.8$, $p < .001$), *Environment* ($B = 5.8$, $p < .001$), and *Regulation* ($B = 4.2$, $p < .001$) as well as low agreement with the factors of *Discomfort* ($B = -4.3$, $p < .001$) and *Underestimation of danger* ($B = -1.9$, $p < .013$), were associated at a statistically significant level with higher frequency of self-reported helmet use.
Conclusion: The evidence derived from this study could be useful in understanding the priorities for future intervention. Continuous education programs and intensification of law enforcement, particularly at night hours, may be effective in increasing helmet use.

1. Introduction

Motorcycle crashes account for a high proportion of traffic related injuries and deaths (Dandona, Kumar, Raj, & Dandona, 2006; Nakahara, Chadbunchachai, Ichikawa, Tipsuntornsak, & Wakai, 2005; Orsi, Marchetti, Marinoni, & Morandi, 2009). In Greece the number of deaths and injuries due to road traffic accidents is significantly higher than in other EU member states (OECD, 2009). More specifically, almost 1500 people are killed annually (14.4 per 100,000 inhabitants) and tens of thousands

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are injured and road traffic crashes are the leading cause of death in the ages 18–24 years (Chliaoutakis, Gnardellis, Drakou, Darviri, & Sboukis, 2000). Although motorcyclists in Greece represent a small percentage of road users (16.5%), they account for 35.8% of deaths from motor crashes. Available statistics for the year 2006 show that 55% of all deaths and 61.8% of all the seriously injured in traffic crashes in Attica (Athens region) were motorcyclists. Furthermore, head injuries have been shown to be the leading cause of death in crashes involving motorcycles with 80% of all the motorcyclists killed in road crashes shown to have suffered traumatic brain injury (Bikes, 2012).

Several studies have linked un-helmeted driving to more frequent and more severe injuries, disabilities, longer hospitalizations, increased mortality, and significantly higher hospital charges (Brown, Hejl, Bui, Tips, & Coopwood, 2011; Croce et al., 2009; Crompton et al., 2010; Liu et al., 2008; Nakahara et al., 2005; Yu, Chen, Chiu, & Lin, 2011; Zargar & Karbakhsh, 2006). On the other hand, a significant body of research has documented the positive effect of motorcycle helmet use legislation on head and brain injuries (Coben, Steiner, & Miller, 2007; French, Gumus, & Homer, 2009; Houston & Richardson, 2008; Hyder, Waters, Phillips, & Rehwinkel, 2007; Passmore, Tu, Luong, Chinh, & Nam, 2010). Nevertheless, low numbers of helmet users are still reported in several countries such as some States of the USA (Brown et al., 2011; Croce et al., 2009; Mayrose, 2008; Ranney, Mello, Baird, Chai, & Clark, 2010), China (Li, Li, Cai, Zhang, & Lo, 2008), Malaysia (Kulanthayan, Umar, Hariza, Nasir, & Harwant, 2000), Vietnam (Hung, Stevenson, & Ivers, 2008), Thailand (Suriyawongpaisal & Kanchanusut, 2003), India (Sreedharan, Muttappillymyalil, Divakaran, & Haran, 2010), Pakistan (Khan, Khan, Aziz, Islam, & Shafqat, 2008), Iran (Zargar & Karbakhsh, 2006), Nigeria (Oginni, Ugboko, & Adewole, 2007), Argentina (Beltramino & Carrera, 2007), Italy (Pileggi, Bianco, Nobile, & Angelillo, 2006). Low helmet use was also reported in the capital city of Greece with the frequency of helmet use to be 20.2% and adolescents in middle-income areas to demonstrate the lowest rate of helmet use comparing to other age groups (Germeni, Lionis, Davou, & Petridou, 2009; Skalkidou, Petridou, Papadopoulos, Dessypris, & Trichopoulos, 1999).

This low compliance with legislation on mandatory helmet use has attracted the attention of several researchers worldwide and a number of research studies have been commenced attempting to identify barriers and facilitators of helmet use among personal and psychological characteristics of the rider, sociocultural factors and helmet features (Zamani, Bazargan, Shafiei, & Bazargan, 2011). In light of these studies, a number of factors have been found to distinguish riders more likely to use helmet from riders unlikely to use it. Among these factors, a number of socio-demographic characteristics have been associated with helmet use, with the most common being the age, gender, educational level, marital status and the history of motorcycle crashes. In particular, young riders, male, less educated, unmarried, unlicensed and those with previous accident involvement were less likely to use helmet (Kulanthayan et al., 2000; Ranney et al., 2010; Sreedharan et al., 2010). A number of environmental factors have also been linked to helmet use such as the road type, the weather and the time of day (Gkritza, 2009; Hung et al., 2006; Li et al., 2008; Nakahara et al., 2005; Skalkidou et al., 1999). Likewise, a number of helmet features have been shown to reduce the likelihood of using a helmet due to causing discomfort or influencing the rider's perception such as noisiness, temperature, poor ventilation, field of vision, functional and design errors (Bogerd, Rossi, & Bruhwiler, 2010; Buyan et al., 2006; Kennedy, Adetifa, Carley, Holt, & Walker, 2011; Mlynski, Kozlowski, & Zera, 2009; Orsi et al., 2012). Riders' beliefs and attitudes towards helmet use have also been shown to affect their helmet use practices with beliefs about injury prevention and safety being among the major facilitators of helmet use and beliefs about physical discomfort and limited vision and hearing, being major barriers of helmet use (Khan et al., 2008; Li et al., 2008; Ranney et al., 2010; Skalkidou et al., 1999).

In light of these findings, it is usually assumed in research studies that each rider exhibits the same behavior at all times and that riders either use a helmet or they do not. However, helmet use may vary in the same rider and certain factors may encourage a rider to use a helmet, while other factors may deter him/her from using it. As these barriers and facilitators usually co-exist in each rider, they should be studied in conjunction in order to adequately describe the profile of riders most likely to use a helmet. According to this view, the current study aimed at assessing (a) the prevalence of self-reported helmet use on different occasions, (b) the driving habits of the riders, i.e., whether a rider tends to be helmeted at specific trips and unhelmeted at other trips, (c) the motivations of the riders to use or not to use a helmet and, (d) the factors that may influence the riders' decision to use or not to use a helmet. It was hypothesized that male riders of young age and less educational attainment, those with less riding experience and high alcohol consumption, those who ride more frequently during summer and spring and during night hours are unlikely to use a helmet. It was further assumed that certain beliefs about helmet use either encourage or deter riders from using a helmet.

There are certain circumstances that stress the importance of this study. Firstly, there is no consistent evidence on the effectiveness of the existing interventions and strategies to increase helmet use and promote motorcycle safety (e.g. law enforcement programs, information and education campaigns, personal protective equipment and conspicuity, motorcycle rider licensing, motorcycle rider education and training) and the need to identify the optimal intervention strategy to increase motorcycle safety has been underlined (NHTSA, 2011) Several new initiatives have been commenced with the most recent and promising ones, employing motorcycle simulators (Crundall, Crundall, & Stedmon, 2012; Shahar, Poulter, Clarke, & Crundall, 2010). In light of this general call for effective interventions, the current study generates useful evidence facilitating understanding of national priorities and assisting in the development of evidence-based and thus more effective future interventions tailored to the needs of the population of interest. Secondly, the current study is important due to being conducted in a country that lacks interventions in this area although confronted with a high incidence of injuries among motorized two-wheeled vehicle riders.

2. Methods

2.1. Statistical design

A probabilistic, stratified random sampling was performed to select 405 riders aged 19–65 years from three cities of Crete, using information and the regulations of the National Statistic Department. A two-staged conglomerate sampling was performed, with sub-sampling and stratification of the first units that were the censual sections in which the three cities are divided. Once the censual sections used for sampling had been selected, all existing households were counted, and a list of homes (two per censual section) was drawn by simple random sampling, without replacement, from the total list homes. The variables used to stratify the sample to be selected were: sex, age, and motorcycle driver license.

2.2. Data collection

Data were collected through an easy-to-use self-administered questionnaire during face-to-face contacts with the study participants. A team of social work students on their last year of studies performed the data collection after receiving 12-h of training. Participants were informed on the study aims and procedures as well as on their rights to anonymity and confidentiality and were requested to provide consent prior to participation. The interviewers were present during the data collection and their role was limited to the provision of instructions and clarifications. For quality control purposes, 10% of all the study questionnaires were randomly selected and assessed in terms of accuracy of the information. The response rate was 93%.

2.3. Measures

2.3.1. Helmet use

Participants were asked to report the frequency of riding a motorcycle as well as the frequency of using a helmet in thirteen situations/conditions, eight of them related to the trip destination/place (e.g. "*when going home*", "*when going to work/school*", "*when going to a bar, night club*") and five related to the rider's emotional condition (e.g. angry, happy, sad). Response options could range from (0) never to (5) always. The composite score of the responses to the thirteen items constituted the frequency of *Helmet Use* and could range from 0 to 65.

2.3.2. Helmet use motivation

For the needs of the current study, two different scales were used after adaptation to measure the facilitators and the barriers of self-reported helmet use, which were developed by the authors of the current paper and tested in previous research (Chliaoutakis et al., 2000). These scales are described as follows:

2.3.2.1. Facilitators of helmet use. Participants were requested to rate the extent to which they were positively motivated to use a helmet in 30 situations/conditions, using a six point Likert scale ranging from 0 (never) to 5 (always). Examples of these situations are the following: "Wearing a helmet wipes off my co-passenger's fear", "I wear a helmet because I have a history of accident involvement as a rider", "Wearing a helmet makes me feel less stressed", "I wear a helmet because I don't trust the other riders", etc.

2.3.2.2. Barriers of helmet use. Participants were also requested to rate the extent to which they were unfavorably motivated towards using a helmet in another set of 30 situations/conditions, using a six-point Likert scale that ranged from 0 (never) to 5 (always). Examples of these situations are "The helmet limits my visibility", "I don't wear helmet because I have regular stops", "I don't need a helmet because I am driving slowly", "The helmet prevents me from using a mobile phone", etc.

2.3.3. Socio-demographic and lifestyle characteristics

The questionnaire further drew information on the *socio-demographic characteristics* (sex, age, years of education, occupation), the alcohol consumption and the riding patterns (annual mileage, driving frequency, experience, season and hour of day when riding is taking place, number of collisions).

2.4. Statistical analysis

A Principal Component Analysis (PCA) was carried out with varimax rotation to reduce the dimensionality of the data. As regards to the facilitators of *Helmet Use*, a five-factor scale was created including the major facilitators of helmet use and explaining 63.2% of the total variance. The first factor accounted for 37.2% of the variance, consisted of seven items and was named *Imitation* (e.g. "I wear a helmet because I set an example to others", "I wear a helmet because I imitate my friends"). The second factor, accounting for 8.8% of the variance, consisted of eight items and was called *Experience* (e.g. "I wear a helmet because I have a history of accident involvement as a rider", "I wear a helmet because I have a history of accident involvement as a co-passenger"). The third factor included items related to *Self-Protection* (e.g. "Wearing a helmet

protects me from injuries", "I wear a helmet because I don't trust the other riders") and accounted for 6.8% of the variance. The fourth factor comprised items related to the *Environmental conditions* (e.g. "I wear a helmet when I am riding in bad weather conditions", "I wear a helmet when I am riding in unknown areas") and accounted for 6.1% of the variance. The fifth factor and accounted for 4.3% of the variance and consisted of four items related to *Regulation (*e.g. "I wear a helmet to be in compliance with traffic regulations", "I wear a helmet to avoid law penalties").

Another model of PCA was calculated for the 30 items of the *Barriers of Helmet Use* and resulted in a three-factor scale including the major barriers of helmet use. This model explained 55.8% of the total variance. The first of the three factors accounted for 41.7% of the variance, contained fifteen items and was labeled *Discomfort* (e.g. "The helmet limits my visibility", "The helmet limits my hearing"). The second factor included eight items concerning the *Underestimation of danger* (e.g. "I am experienced enough to need a helmet", "I don't need a helmet since I only ride short distances") and accounted for 9.3% of the variance. Finally, the third factor received salient loadings on 10 items concerning *Risky Behavior* (e.g., "I am a risk-taking person", "The helmet prevents me from smoking") and accounted for 4.8% of the variance. The results of the principal components analysis are shown in the Appendix A.

All the eight factors that derived from the PCA were used in a multiple linear regression model, which was calculated to measure the combined effects of the sociodemographic, the environmental, the trip-related characteristics as well as the motivational aspects on the frequency of *Helmet Use.* In particular, the variables entered into the regression analysis as independent variables were the following: (a) gender, age and years of education, (b) low and high concentrated alcohol consumption, (c) mileage, season and hour of day when riding is taking place, (d) facilitators and barriers of self-reported helmet use (the eight factors extracted by the PCA models).

2.5. Instrument reliability

A Cronbach's alpha coefficient was calculated separately for each one of the five components of *Helmet Use Facilitators* and the three components of *Helmet Use Barriers* respectively in order to determine the item homogeneity and reliability of each scale. Based on 403 responses, the alpha coefficient was found to be at a high value for each scale (*Imitation*, $\alpha = .890$; *Experience* $\alpha = .862$; *Self protection* $\alpha = .875$; *Environment*, $\alpha = .898$; *Regulation* $\alpha = .751$; *Discomfort* $\alpha = .939$*; Underestimation of danger* $\alpha = .858$ and *Risky behavior*, $\alpha = .882$). The result for the composite score of the frequency of *Helmet Use* was satisfactory as well ($\alpha = .913$).

3. Results

3.1. Participants' profile

Overall, 405 riders participated in the study (53.3% men). In mean, they were aged 28.0 (±9.4) years and had 13.0 (±3.0) years of education. The mean number of glasses of low (wine, beer, etc.) and high (ouzo, raki, whisky) alcohol concentrated beverages consumed per week were 3.6 (±5.7) and 4.0 (±7.0) respectively. As regards the riding characteristics, participants reported riding 53.150 km (±101.023) per year, had 9.2 (±7.3) years of riding experience, owned the motorcycle for 8.3 (±7.1) years, and held a driver's licence for 7.2 (±7.6) years. Almost half of the participants (46.8%) were involved in a collision within the previous 3 years (Table 1).

3.2. Frequency of helmet use

The overall self-reported helmet use was very low (24.6 ± 18.4). Table 2 shows the frequency of motorcycle riding and the self-reported helmet use in different trip destination/places and under various emotional conditions of the rider. In particular, the most frequently reported destinations/places where motorcycle riding occurred were "when going home" (Mean = 3.8; S.D. = 1.3), "when going to work or school" (Mean = 3.3; S.D. = 1.8) as well as "When going around without specific destination" (Mean = 2.9; S.D. = 1.6). The most frequently reported emotional conditions under which motorcycle riding occurred, were "When I am happy or excited" (Mean = 2.5; S.D. = 1.6), "when I am angry or pissed off" (Mean = 1.9; S.D. = 1.8) and "when I feel sad or depressed" (Mean = 1.9; S.D. = 1.8) and the less frequently reported emotional conditions were "when feeling competitive or joyful" (Mean = 0.6; S.D. = 1.4). Likewise, helmet use was reported more frequently "when going home" (Mean = 2.7; S.D. = 2.0) and "when going to work or school" (Mean = 2.7; S.D. = 2.1) and less frequently "when travelling" (Mean = 1.7; S.D. = 2.3) and "while being at work/school" (Mean = 1.8; S.D. = 2.1). Helmet use was frequently reported when participants were "happy or excited" and less frequently when they felt "competitive or joyful" (Mean = 0.6; S.D. = 1.5) and when they were "flirting with the opposite sex" (Mean = 0.7; S.D. = 1.6).

Table 3 shows the frequency of motorcycle riding and self-reported helmet use in the different seasons and hours of the day. In particular, riding a motorcycle was reported more frequently during the Summer (Mean = 4.5; S.D. = 0.8) and between 2 p.m. and 10 p.m. (Mean = 3.5; S.D. = 1.2) and less frequently during the Winter (Mean = 2.0; S.D. = 1.6) and between 10 p.m. and 6 a.m. (Mean = 1.9; S.D. = 1.7). On the other hand, the use of helmet was reported less frequently during Spring (Mean = 2.1; S.D. = 1.9) compared to the other seasons and between 10 p.m. and 6 a.m. (Mean = 2.0; S.D. = 2.0) compared to the other hours of the day.

Table 1
Distribution of study subjects by socio-demographic and riding characteristics.

Socio-demographic characteristics	*N*	%
Gender		
Men	216	53.3
Women	189	46.7
Occupation		
Self-employed, Scientists, etc.	36	9.0
Traders	20	5.0
White collars	125	31.2
Sector of services	29	7.2
Blue collars	36	9.0
Housewives	14	3.5
Students, soldiers	120	29.9
Unemployed, etc.	21	5.2
Age[a]	28	9.4
Years of education[a]	13.0	3
Alcohol consumption (Number of glasses per week)		
Low alcohol concentrated beverages (wine, beer, etc.)	3.6	5.7
High alcohol concentrated beverages (ouzo, raki, whisky)	4.0	7.0
Riding characteristics		
Mileage[a]	53.150	101.023
Years of motorcycle riding experience[a]	9.2	7.3
Years of motorcycle possession[a]	8.3	7.1
Years of motorcycle riding license possession[a]	7.2	7.6
Motorcycle collisions (last 3 years)	*N*	%
None	218	54.2
One crash	90	22.4
Two crashes	43	10.7
Three crashes or more	51	12.7

[a] Mean, standard deviation.

Table 2
Motorcycle riding and helmet use scores according to the trip destination/place and the emotional condition of the rider.

		Riding mean (SD)	Helmet use mean (SD)
Trip destination/place			
1	When going home	3.8 (1.3)	2.7 (2.0)
2	When going to work/school	3.3 (1.8)	2.7 (2.1)
3	While being at work/school	2.1 (2.0)	1.8 (2.1)
4	When going to a bar, a night club or similar	2.3 (1.7)	2.1 (2.1)
5	When returning from a bar, a night club or similar	2.3 (1.7)	2.2 (2.1)
6	When going around without specific destination	2.9 (1.6)	2.5 (2.1)
7	When traveling	1.1 (1.6)	1.7 (2.3)
8	When going to a sport or professional club, etc.	1.9 (1.6)	2.1 (2.1)
Emotional condition			
9	When I am angry or pissed off	1.9 (1.8)	1.5 (2.0)
10	When I am happy or excited	2.5 (1.6)	2.1 (2.1)
11	When I feel sad or depressed	1.9 (1.8)	1.6 (2.0)
12	When I am flirting with the opposite sex	1.0 (1.6)	0.7 (1.6)
13	When I feel competitive or joyful, etc.	0.6 (1.4)	0.6 (1.5)

Never = 0, rarely = 1, sometimes = 2, often = 3, very often = 4, always = 5.

3.3. The impact of the background and the riding characteristics on the frequency of Helmet Use

Among the socio-demographic characteristics and riding, gender, years of education, consumption of high concentrated alcohol, and time of day where riding is taking place, were related at a statistically significant level with the frequency of *Helmet Use*. More specifically, men and riders with less years of education were less likely to use a helmet comparing to women and riders with less educational attainment ($B = -5.1$, $p = .002$ and $B = 0.5$, $p = .032$, respectively). In addition, participants reporting less consumption of high-concentrated alcohol and those riding between 2 p.m. and 10 p.m. were more likely to use a helmet comparing to those reporting more consumption of high-concentrated alcohol and those riding during early morning hours ($B = -0.3$, $p = .002$ and $B = 2.0$, $p = .002$, respectively) (Table 4).

Table 3
Motorcycle riding and helmet use scores according to the season and the hour of the day.

	Riding mean (SD)	Helmet use mean (SD)
Season		
Autumn	2.9 (1.5)	2.9 (2.0)
Winter	2.0 (1.6)	2.8 (2.1)
Spring	3.9 (1.1)	2.1 (1.9)
Summer	4.5 (0.8)	2.8 (2.0)
Hours of day		
6 a.m. to 2 p.m.	2.9 (1.6)	2.7 (2.0)
2 p.m. to 10 p.m.	3.5 (1.2)	2.8 (2.0)
10 p.m. to 6 a.m.	1.9 (1.7)	2.0 (2.0)

Never = 0, rarely = 1, sometimes = 2, often = 3, very often = 4, always = 5.

Table 4
Multiple linear regression coefficients and *p*-values of composite frequency of helmet use.[a]

	B	Std. error	*p*-Value[b]
(Constant)	12.641	7.263	.083
Gender			
Males	−5.087	1.601	**.002**
Females (reference category)			
Age (years)	−.097	.085	.253
Education (years)	.532	.248	**.032**
Alcohol consumption			
Low alcohol capacity beverages (wine, beer etc.)	.163	.133	.221
High alcohol capacity beverages (ouzo, raki, whisky)	−.377	.120	**.002**
Mileage (per 10,000 km)	−0.06	.000	.503
Season			
Autumn	.080	.738	.914
Winter	.546	.681	.423
Spring	−1.297	.946	.171
Summer	1.931	1.104	.081
Hours of day			
6 a.m. to 2 p.m.	.688	.534	.199
2 p.m. to 10 p.m.	2019	.657	**.002**
10 p.m. to 6 a.m.	.973	.494	.050
Facilitators of helmet use			
Imitation	5.381	.791	**<.001**
Experience	2.571	.751	**<.001**
Self-protection	3.778	.789	**<.001**
Environment	5.763	.734	**<.001**
Regulation	4.220	.733	**<.001**
Barriers of helmet use			
Discomfort	−4.319	.793	**<.001**
Underestimation of danger	−1.877	.751	**.013**
Risky behavior	.066	.814	.935

[a] *R* square = .498; adjusted *R* square = .468.
[b] Values in bold are statistically significant at the level of < .05.

3.4. Barriers and facilitators of helmet use and their impact on the frequency of helmet use

Based on the results of the statistical analysis, high agreement with the items included in the factors of *Imitation* ($B = 5.4$, $p < .001$), *Experience* ($B = 2.6$, $p = .001$), *Self-protection* ($B = 3.8$, $p < .001$), *Environment* ($B = 5.8$, $p < .001$), and *Regulation* ($B = 4.2$, $p < .001$) as well as low agreement with the items included in the factors of *Discomfort* ($B = -4.3$, $p < .001$) and *Underestimation of danger* ($B = -1.9$, $p < .013$), were associated at a statistically significant level with higher frequency of *Helmet Use* (Table 4).

4. Discussion

While motorcyclists and their passengers in Greece are required to use helmets according to the national legislation, this study found a very low frequency of self-reported helmet use. Low helmet use was also evident in other Greek studies, implying that the legal code alone is unlikely to be effective in changing motorcyclist behavior (Germeni et al., 2009; Skalkidou et al., 1999).

What stands out of the results is that a number of facilitators and barriers of helmet use were identified and could guide future interventions. All the facilitators investigated in the current study were found to have a strong impact on self-reported helmet use and similar findings are reported in the international literature. Most importantly, young people who reported adopting their relatives' or friends' practices were more likely to use a helmet. This could imply that people who share and respect good practices at home or at friendly environments are more likely to respect the laws and regulations on helmet use. In line with our finding, role models and peer influence were found to predict young riders' opinions of helmet use in previous research (Germeni et al., 2009; Zamani et al., 2011). Not surprisingly, people who believed that helmet increases safety were found in the current study to be more likely to use a helmet and this replicates previous well established findings (Khan et al., 2008; Ranney et al., 2010). Similarly, the traumatic experience of previous involvement in crashes was associated in the current study with higher helmet use and this could be the result of a learning process. Although this finding is common in previous research, Ranney et al. (2010) and Kulanthayan et al. (2000) found that people having a history of previous accidents or traffic injuries are more likely not to use a helmet probably as part of an overall risky riding behavior. Moreover, our analysis indicated that a helmet was more likely to be used when riding in bad weather, in unknown areas, in narrow and bad roads and in heavy traffic. This finding was highly expected as helmet use has been shown to increase the feelings of safety especially in adverse weather and road conditions. Similar studies have demonstrated low helmet use to be related with riding in city and secondary roads, in evening and night hours, in warm and sunny days (Gkritza, 2009; Hung et al., 2006; Li et al., 2008; Nakahara et al., 2005; Skalkidou et al., 1999). Not surprisingly, the fear of the consequences of breaking the law was found in our study to be an important factor that increased self-reported helmet use. In general, universal helmet laws have been demonstrated to be effective at increasing helmet use (Kraus, Peek, & Williams, 1995), while several observational surveys have reported that helmet use dropped dramatically after repeals of universal coverage (Kyrychenko & McCartt, 2006; Ulmer & Preusser, 2003).

Among the barriers that were identified as having an influence on self-reported helmet use were the *Discomfort* and the *Underestimation of danger.* Discomfort of the helmet seems to be an important barrier of helmet use in previous research (Khan et al., 2008; Li et al., 2008; Ranney et al., 2010; Skalkidou et al., 1999). Despite that, Orsi et al. (2012) found that, even though the majority of riders were dissatisfied with their helmets, complaints did not seem to be associated with the objective features of the helmet. Nevertheless improving helmet comfort in order to increase their level of user satisfaction seems to be important. Not surprisingly, people who underestimated the danger were less likely to use a helmet (Chen, 2009). This is a common characteristic of young populations and should be the focus of primary prevention efforts.

In addition, the likelihood of self-reported helmet use was higher during the afternoon and early evening hours and lower during the morning and night hours. This is also in line with previous studies indicating a lower helmet use during the night hours (Li et al., 2008; Nakahara et al., 2005; Skalkidou et al., 1999). In line with helmet use, severity of injuries for motorcycle riders has been shown to be higher during the night hours (Orsi, Marchetti, Marinoni, & Morandi, 2009). Possible reasons are high alcohol consumption and low police control. In this regard, regular controls by the police during the night hours could contribute to higher compliance with mandatory helmet use regulations.

As for the sociodemographic characteristics, our findings demonstrated that women are more likely to use a helmet comparing to men and this is in line with other studies (Kulanthayan et al., 2000; Ranney et al., 2010; Skalkidou et al., 1999; Sreedharan et al., 2010). When it comes to the educational level, a positive association between educational level and helmet use was also found in previous studies (Kulanthayan et al., 2000; Ranney et al., 2010;). This could be due to the fact that less educated people are less informed about the risks of road accidents and the importance of the helmet as a protective factor. This finding could suggest that improving public education could lead to higher compliance with helmet regulation. Consistently with previous research (Brown et al., 2011; Sreedharan et al., 2010), there was a positive association between alcohol consumption and lack of helmet use. It seems that alcohol may impair the judgment and evaporate the need to wear a helmet while riding.

4.1. Study limitations

Although this study was very effective in interpreting the Greek riders' behavior, it suffers certain limitations that should be mentioned for future reference. In particular, the major limitation of this work is the self-reported nature of the study, which may have affected the accuracy of reporting. It should be noted however that people usually over-report helmet use due to various reasons including the fear of consequences and therefore this limitation might not have affected self-reported helmet use rates in our study. Future studies could employ other methods to better monitor motorcyclist behavior in order to prevent biased reporting from occurring. Furthermore, the sample was selected from three cities of Greece and thus the findings cannot be generalized to all the Greek motorcycle riders. Another limitation is related to the lack of information on other factors that could affect helmet use, such as the riders' attributes, the type of motorcycle, the type of helmet, the traffic volumes, which may equally affect helmet use. Future research could take into account other major factors widely acknowledged in international literature.

5. Conclusions

This study investigates a major public health problem that contributes to the high incidence of injuries among motorized two-wheeled vehicle riders in Greece. The evidence derived from this study could be useful in informing policy makers and improving future intervention. In particular, the current study identified significant others such as peers and relatives in the

motorcyclists' immediate social context as playing an important role and greatly affecting participants' behaviors towards helmet use. In light of this finding, peer education methods could be very promising in future interventions. Furthermore, parents' education could also be employed to raise parents' awareness and help them value the importance of children's helmet and promote safer models to their children. The current study also identified the fear of law consequences as a major facilitator of helmet use and this finding could guide legislative measures and policies to reduce risk behaviors in adolescents who use motorcycles. Countermeasures could also include intensification of law enforcement, mostly at night, when helmet use is limited and motorcycle crashes are prevalent. High cost penalties and strict controls by the police could also act as a strong motivation for motorcycle riders to use a helmet and this identifies the police as a key actor with a leading role in the problem. Helmet discomfort was currently found to act as a major barrier of helmet use and this finding highlights the need to reinforce manufacturers and provide them with motives to design and produce helmets that not only protect the safety of their customers, but provide comfort and affordability as well. Most importantly, the current study identified the existence of unfavorable beliefs and attitudes that riders hold (e.g. beliefs about underestimation the danger), as playing a discouraging role in helmet use. This greatly highlights the need to develop educational programs aiming to change unfavorable attitudes towards helmet use and improve the skills and safety practices of young riders. In conclusion, this study provides an important evidence in the direction of developing tailored and evidence-based intervention programs aimed at improving safe attitudes and increasing helmet use among motorcycle riders.

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Appendix A

See Tables A1 and A2.

Table A1
PCA of the 30 items of *Helmet Use Facilitators* following varimax rotation.

Items	Factors				
	Imitation	*Experience*	*Self protection*	*Environment*	*Regulation*
I wear a helmet because I set an example to others	.665				
I wear a helmet because I have appropriate education	.637				
I wear a helmet because I imitate my family	.677				
I wear a helmet because I imitate my friends	.660				
Wearing a helmet wipes off my co-passenger's fear	.708				
Wearing a helmet helps me being confident/consistent	.728				
Wearing a helmet helps me deal with my fears in general	.501				
I wear a helmet because I have a history of accident involvement as a rider		.678			
I wear a helmet because I have a history of accident involvement as a co-passenger		.754			
I wear a helmet because of a previous experience of my relative/friend's accident		.647			
I wear a helmet because of a previous experience of witnessing an accident		.689			
I wear a helmet because I am afraid of losing working hours		.627			
I wear a helmet because I am uninsured		.625			
I wear a helmet due to being inexperienced		.546			
Wearing a helmet makes me feel less stressed		.581			
Wearing a helmet protects me from injuries			.756		
Wearing a helmet makes me feel safe			.741		
Wearing a helmet makes me feel stable			.431		
Wearing a helmet protects me in high speed driving			.709		
Wearing a helmet protects me from fatal accidents			.816		
I wear a helmet because I don't trust the other riders			.682		
I wear a helmet when I am riding in bad weather conditions				.636	
I wear a helmet when I am riding in unknown areas				.804	
I wear a helmet when I am riding in bad road surfaces				.793	
I wear a helmet when I am riding in narrow roads				.787	
I wear a helmet when I am riding in heavy traffic				.735	
I wear a helmet to be in compliance with traffic regulations					.609
I wear a helmet to be in compliance with state rules					.607
I wear a helmet to avoid law penalties					.794
I wear a helmet to avoid my motorcycle being removed by the police					.746

Table A2
PCA of the 30 items of *Helmet Use Barriers* following varimax rotation.

Items	Component		
	Discomfort	*Underestimation of danger*	*Risky behavior*
I am chocking when I use a helmet	.781		
The helmet feels heavy on my head, shoulders	.805		
The helmet limits my visibility	.777		
The helmet limits my head movement	.777		
The helmet limits my hearing	.750		
The helmet limits my communication with co-passengers	.739		
The helmet limits my breath	.701		
The helmet is difficult to clean while riding (dust, insects etc.)	.566		
I am usually in a hurry thus I don't wear a helmet	.592		
I don't wear helmet because I have regular stops	.695		
The helmet makes my hair messy	.543		
The helmet introduces itchiness	.658		
The helmet warms my head	.748		
I don't care about wearing a helmet	.510		
I don't wear helmet because I think it wastes my time (put on – put off)	.536		
I don't need a helmet because I am driving slowly		.734	
I don't need a helmet because my bike is safe		.763	
I am experienced enough to need a helmet		.767	
Helmet is useless because it can't save your life in the case of an accident		.580	
Fatal accidents can't happen to people like me		.604	
I don't need a helmet since I only ride short distances		.510	
The helmet cannot protect me		.536	
The helmet is not in line with my professional and social status		.688	
I am not always in compliance with regulations			.654
I usually go against the mainstream			.652
I am not a well-mannered person			.662
I am a risk-taking person			.741
I am a man of action			.732
I am not afraid of death			.572
Wearing a helmet could harm my personal image and prestige			.438
Well-looking guys don't use helmets			.491
The helmet prevents me from smoking			.542
The helmet prevents me from using a mobile phone			.534

References

Beltramino, J. C., & Carrera, E. (2007). Traffic law compliance in the city of Santa Fe, Argentina. *Revista Panamericana de Salud Publica, 22*(2), 141–145.

Bikes (2012). <http://allaboutbikes.gr/?p=260> Accessed 06.06.12.

Bogerd, C. P., Rossi, R. M., & Bruhwiler, P. A. (2010). Thermal perception of ventilation changes in full-face helmets: Subject and manikin study. *Annals of Occupational Hygiene, 55*(2), 192–201.

Brown, C. V. R., Hejl, K., Bui, E., Tips, G., & Coopwood, B. (2011). Risk factors for riding and crashing a motorcycle unhelmeted. *Journal of Emergency Medicine, 41*(4), 441–446.

Buyan, M., Bruhwiler, P. A., Azens, A., Gustavsson, Greger, Karmhag, R., & Granqvist, C. G. (2006). Facial warming and tinted helmet visors. *International Journal of Industrial Ergonomics, 36*(1), 11–16.

Chen, C. F. (2009). Personality, safety attitudes and risky driving behaviors—Evidence from young Taiwanese motorcyclists. *Accident Analysis and Prevention, 41*, 963–968.

Chliaoutakis, J. E., Gnardellis, C., Drakou, I., Darviri, C., & Sboukis, V. (2000). Modelling the factors related to the seatbelt use by the young drivers of Athens. *Accident Analysis and Prevention, 32*, 815–825.

Coben, J. H., Steiner, C. A., & Miller, T. R. (2007). Characteristics of motorcycle-related hospitalizations: Comparing states with different helmet laws. *Accident Analysis and Prevention, 39*, 190–196.

Croce, M. A., Zarzaur, B. L., Magnotti, L. J., Fabian, T. C., Croce, M. A., Zarzaur, B. L., et al (2009). Impact of motorcycle helmets and state laws on society's burden: A national study. *Annals of Surgery, 250*, 390–394.

Crompton, J. G., Oyetunji, T., Stevens, K. A., Efron, D. T., Haut, E. R., & Haider, A. H. (2010). Motorcycle helmets save lives, but not limbs: A National Trauma Data Bank analysis of functional outcomes after motorcycle crash. *Journal of Surgical Research, 158*, 1–5.

Crundall, E., Crundall, D., & Stedmon, A. W. (2012). Negotiating left-hand and right-hand bends: A motorcycle simulator study to investigate experiential and behaviour differences across rider groups. *PLoS One, 7*(1), e29978. http://dx.doi.org/10.1371/journal.pone.0029978.

Dandona, R., Kumar, G. A., Raj, T. S., & Dandona, L. (2006). Patterns of road traffic injuries in a vulnerable population in Hyderabad, India. *Injury Prevention, 12*, 183–188.

French, M. T., Gumus, G., & Homer, J. F. (2009). Public policies and motorcycle safety. *Journal of Health Economics, 28*, 831–838.

Germeni, E., Lionis, C., Davou, B., & Petridou, E. (2009). Understanding reasons for non-compliance in motorcycle helmet use among adolescents in Greece. *Injury Prevention, 15*, 19–23.

Gkritza, K. (2009). Modeling motorcycle helmet use in Iowa: Evidence from six road-side observational surveys. *Accident Analysis and Prevention, 41*(3), 479–484.

Houston, D. J., & Richardson, L. E. (2008). Motorcyclist fatality rates and mandatory helmet-use laws. *Accident Analysis and Prevention, 40*(1), 200–208.

Hung, D. V., Stevenson, M. R., & Ivers, R. Q. (2006). Prevalence of helmet use among motorcycle riders in Vietnam. *Injury Prevention, 12*, 409–413.

Hung, D. V., Stevenson, M. R., & Ivers, R. Q. (2008). Motorcycle helmets in Vietnam: Ownership, quality, purchase price, and affordability. *Traffic Injury Prevention, 9*, 135–143.

Hyder, A. A., Waters, H., Phillips, T., & Rehwinkel, J. (2007). Exploring the economics of motorcycle helmet laws—Implications for low and middle-income countries. *Asia-Pacific Journal of Public Health, 19*, 16–22.
Kennedy, J., Adetifa, O., Carley, M., Holt, N., & Walker, I. (2011). Aeroacoustic sources of motorcycle helmet noise. *Journal of the Acoustical Society of America, 130*(3), 1164–1172.
Khan, I., Khan, A., Aziz, F., Islam, M., & Shafqat, S. (2008). Factors associated with helmet use among motorcycle users in Karachi, Pakistan. *Academic Emergency Medicine, 15*(4), 384–387.
Kraus, J. F., Peek, C., & Williams, A. (1995). Compliance with the 1992 California motorcycle helmet use law. *American Journal of Public Health, 85*, 96–99.
Kulanthayan, S., Umar, R. S., Hariza, H. A., Nasir, M. T., & Harwant, S. (2000). Compliance of proper safety helmet usage in motorcyclists. *Medical Journal of Malaysia, 55*(1), 40–44.
Kyrychenko, S. Y., & McCartt, A. T. (2006). Florida's weakened motorcycle helmet law: Effects on death rates in motorcycle crashes. *Traffic Injury Prevention, 7*, 55–60.
Li, L., Li, G., Cai, Q., Zhang, A. L., & Lo, S. K. (2008). Improper motorcycle helmet use in provincial areas of a developing country. *Accident Analysis and Prevention, 40*(6), 1937–1942.
Liu, B. C., Ivers, R., Norton, R., Boufous, S., Blows, S., & Lo, S. K. (2008). Helmets for preventing injury in motorcycle riders. *Cochrane Database Systematic Review, 23*, CD004333.
Mayrose, J. (2008). The effects of a mandatory motorcycle helmet law on helmet use and injury patterns among motorcyclist fatalities. *Journal of Safety Research, 39*, 429–432.
Mlynski, R., Kozlowski, E., & Zera, J. (2009). Attenuation of noise by motorcycle safety helmets. *International Journal of Occupational Safety and Ergonomics, 15*(3), 287–293.
Nakahara, S., Chadbunchachai, W., Ichikawa, M., Tipsuntornsak, N., & Wakai, S. (2005). Temporal Distribution of motorcyclist injuries and risk of fatalities in relation to age, helmet use, and riding while intoxicated in Khon Kaen, Thailand. *Accident Analysis & Prevention, 37*, 833–842.
National Highway Traffic Safety Administration (2011). *Countermeasures that work: A highway safety countermeasure guide for state highway safety offices* (6th ed.). Washington, DC: National Highway Traffic Safety Administration, U.S. Department of Transportation.
OECD (2009). *International traffic safety data and analysis group.* Risk Indicators.
Oginni, F. O., Ugboko, V. I., & Adewole, R. A. (2007). Knowledge, attitude, and practice of Nigerian commercial motorcyclists in the use of crash helmet and other safety measures. *Traffic Injury Prevention, 8*, 137–141.
Orsi, C., Marchetti, P., Marinoni, A., & Morandi, A. (2009). Risk factors for road traffic accidents severity in the province of Milan, Italy. *Biomedical Statistics and Clinical Epidemiology, 3*(3), 141–152.
Orsi, C., Stendardo, A., Marinoni, A., Gilchrist, M. D., Otte, D., Chliaoutakis, J., et al (2012). Motorcycle riders' perception of helmet use: Complaints and dissatisfaction. *Accident Analysis and Prevention, 44*, 111–117.
Passmore, J., Tu, N. T., Luong, M. A., Chinh, N. D., & Nam, N. P. (2010). Impact of mandatory motorcycle helmet wearing legislation on head injuries in Viet Nam: Results of a preliminary analysis. *Traffic Injury Prevention, 11*, 202–206.
Pileggi, C., Bianco, A., Nobile, C. G. A., & Angelillo, I. F. (2006). Risky behaviors among motorcycling adolescents in Italy. *Journal of Pediatrics, 148*, 527–532.
Ranney, M. L., Mello, M. J., Baird, J. B., Chai, P. R., & Clark, M. A. (2010). Correlates of motorcycle helmet use among recent graduates of a motorcycle training course. *Accident Analysis and Prevention, 42*, 2057–2062.
Shahar, A., Poulter, D., Clarke, D., & Crundall, D. (2010). Motorcyclists' and car drivers' responses to hazards. *Transportation Research Part F, 13*, 243–254.
Skalkidou, A., Petridou, E., Papadopoulos, F., Dessypris, N., & Trichopoulos, D. (1999). Factors affecting motorcycle helmet use in the population of Greater Athens, Greece. *Injury Prevention, 5*(4), 264–267.
Sreedharan, J., Muttappillymyalil, J., Divakaran, B., & Haran, J. C. (2010). Determinants of safety helmet use among motorcyclists in Kerala, India. *Journal of Injury and Violence Research, 2*, 49–54.
Suriyawongpaisal, P., & Kanchanusut, S. (2003). Road traffic injuries in Thailand: Trends, selected underlying determinants, and status of intervention. *Injury Control and Safety Promotion, 10*, 95–104.
Ulmer, R. G., Preusser, D. F., 2003. *Evaluation of the repeal of motorcycle helmet laws in Kentucky and Louisiana*. DOT HS 809 602. Washington, DC: U.S. Department of Transportation.
Yu, W. Y., Chen, C. Y., Chiu, W. T., & Lin, M. R. (2011). Effectiveness of different types of motorcycle helmets and effects of their improper use on head injuries. *International Journal of Epidemiology, 40*, 794–803.
Zamani, F. A., Bazargan, M., Shafiei, A., & Bazargan, H. S. (2011). The frequency and predictors of helmet use among Iranian motorcyclists: A quantitative and qualitative study. *Accident Analysis and Prevention, 43*, 1562–1569.
Zargar, M. K. A., & Karbakhsh, M. (2006). Pattern of motorcycle-related injuries in Tehran, 1999 to 2000: A study in 6 hospitals. *East Mediterranean Health Journal, 12*, 81–87.