Developing an international survey of bicycle and helmet usage

N. Haworth[1], D. Shinar[2], T. Oron-Gilad[3]

[1] Centre for Accident Research and Road Safety - Queensland
Queensland University of Technology
130 Victoria Park Road, Kelvin Grove 4059, Australia
e-mail: n.haworth@qut.edu.au

[2] Dept of Industrial Engineering and Management
Ben Gurion University of the Negev
Beer Sheva, Israel
e-mail: shinar@bgu.ac.il

[3] Dept of Industrial Engineering and Management
Ben Gurion University of the Negev
Beer Sheva, Israel
e-mail: orontal@bgu.ac.il

ABSTRACT

The European Union-funded collaborative network, COST Action TU1101: Towards safer bicycling through optimization of bicycle helmets and usage, aims to increase scientific knowledge about bicycle helmets in regards to traffic safety and to disseminate this knowledge to stakeholders, including cyclists, legislators, manufacturers, and the scientific community. The COST research team has developed a uniform international survey to better understand attitudinal and other factors that may influence bicycle and helmet usage, as well as crash risk. The online survey is being distributed by project partners in Europe, Israel, Australia, and potentially the US and Canada. The survey contains four types of questions: (1) biographical data, (2) frequency of cycling and amount of cycling for different purposes (e.g., commuting, health, recreation) and in different environments (e.g., bicycle trails, bike lanes, on sidewalks, in traffic), (3) frequency and circumstances for use and non-use of helmets, attitudes and reasons for it, and (4) crash involvement and level of reporting to the police. While the potential value of comparative data across countries with very different cycling cultures and safety levels is substantial, there are numerous challenges in developing, conducting, and analyzing the results of the survey. This presentation will focus on the scope of the international study, methodological issues and pitfalls of such a collaborative effort, and on initial results from one country (Israel). To illustrate, two findings from the preliminary Israeli survey indicate that: (1) none of the crashes were reported to the police including the ones involving hospital admission. Although underreporting of bicycle crashes by police is well documented in all countries the extent is unknown, and can be extreme. (2) Older riders tend to ride more for health/exercise reasons, while younger riders tend to ride more for commuting. Thus there is an interaction between riders' age and the place and times of riding.

Keywords: bicycle helmets, cycling participation, survey, international comparisons.

1 INTRODUCTION

Motorised travel dominates individual mobility in many countries with huge detrimental impacts on air quality, greenhouse gas emissions, traffic congestion, road trauma and inactivity-related chronic disease. Cycling, in contrast, has health benefits (increased physical activity leading to reduced pressure on health services from chronic disease) and social benefits (meeting new people, building social capital) [1]. Cycling for transport (to work, for errands or local trips) has the additional benefits of reducing traffic congestion and improving quality of life in cities, reducing carbon emissions, and lowering costs of transport and parking [1]. Economic analyses have concluded that the health benefits of active transport far outweigh the injury costs [2-6] but cycling safety continues to be of concern to road safety agencies and is a major reason people give for not riding a bicycle [7-9].

High level international comparisons have shown that the proportion of road fatalities represented by bicyclists is roughly double in low and middle income countries compared to high income countries [10]. Yet these comparisons confound cycling participation and cycling safety, both of which differ markedly across countries. While direct comparisons are not possible given the different data collection methodologies, cycling accounts for approximately 1% of transport mode share for all urban trips in the US, 12% in Germany and 28% in The Netherlands (1995 data) [11]. Even within Europe, cycling participation rates vary dramatically [12]. The daily cycling rate in Denmark is 61% of that in The Netherlands, whereas it is 52% of the Dutch rate in Germany. Other countries have lower levels of bicycle use, such as Poland (26% of Netherlands cycling rates), Romania (16% of Netherlands cycling rates), Greece (10% of Netherlands cycling rates), and Spain, UK and Luxembourg have very low levels (6% of Netherlands cycling rates) [12].

Research has compared bicycle injury rates and fatality rates in the United States, Germany and The Netherlands. Bicycle fatality rates (per 100 million kilometres travelled) and injury rates (per 500,000 kilometres travelled) are highest in the United States (7.2 and 25 respectively), followed by German (3.2 and 1.6 respectively), and The Netherlands (2.0 and 0.4 respectively) [11]. International comparisons of bicycle safety are limited by the paucity of exposure data [12, 13] in many countries and under-reporting of crashes [12, 14-17].

International comparisons of cycling participation often fail to consider differences in the patterns of cycling across countries. Australia and the United States, for example, not only have low rates of cycling participation compared to some European countries [18] but they also have substantially lower participation rates by women than men [19, 20]. While most cycling occurs for transport in countries with high cycling participation rates, it appears that the proportion of cycling that is for recreation, rather than transport, may be greater in low cycling countries such as Australia and the United States. This pattern is even more evident for female riders who make only about quarter of commuter cycling trips [18, 21] but account for about 35% of recreational riders. These differences may reflect the contrasting road user attitudes and behaviours among jurisdictions. Behaviours vary as a result of local policies (and legislation) and traffic culture [22]. Differences in cycling culture between nations suggest an international perspective is needed to develop a comprehensive understanding.

A bicycle helmet is primary safety device available to cyclists. Bicycle helmets have been shown to be effective at reducing the severity of injury, particularly brain injury, in the event of a crash [23]. Bicycle helmet usage rates differ across ages, and between countries. The majority of research has examined helmet use by children, partly at least because of the introduction of mandatory helmet legislation for children only [24, 25]. The research identified large differences in children's riding rates and helmet wearing rates and a decrease in helmet wearing rates as children aged [26, 27]. Several studies have examined helmet use by adults. For Germans aged 17 years or older, the overall helmet wearing rate was 12%, with wearing rates being higher for men (18%) than women (10%), and higher among those who rode less

frequently [28]. Other observational studies in countries without mandatory helmet legislation have shown wearing rates of less than 5% in Paris [29] and rural Georgia in the US, [27], but 24% of adults in Winnipeg, Manitoba [26] and 31.5% in Boston. In Australia, where helmet use has been mandatory for riders of all ages since about 1990, approximately 76% of cyclists were observed wearing helmets in Melbourne (1992) [30], and more recent observations in Brisbane found 97% of cyclists were wearing helmets [31].

A number of factors may influence an individual's decision to use a bicycle helmet when cycling. A review of research found the introduction of legislation increased the proportion of cyclists wearing a bicycle helmet [32], with the actual increase varying between 37% and 91%, across different jurisdictions. Personal factors could pose barriers to bicycle helmet use. Barriers to helmet use are similar for adults and children, and are related to comfort and accessibility [33]. An individual's perception of the safety of cycling in a location may influence helmet use. However, the complex interactions of factors may be difficult to understand. The perceived level of safety protection a helmet offers may be a factor that influences helmet use. Surveys conducted in the United States found that the majority of bicycle riders believed that helmets provided protection from head injury, regardless of whether riders are children, adolescents or adults but the proportion of respondents that used a bicycle helmet was only high for older adults (aged 50 years or older), with only approximately 30% of children, adolescents and adults wearing helmets [33]. Attitudes about bicycle helmet use may also influence helmet wearing. Research in the area of attitudes towards bicycle helmets, and their respective use, has primarily focussed on children and adolescents [34, 35].

International comparison of bicycle rider safety is difficult because of generally poor and inconsistent injury and exposure data. The number of bicycle crashes is the numerator for evaluating bicycle safety. Under-reporting of cycling crashes is a significant problem across jurisdictions and can hide the true nature of bicycle safety [12]. Most analyses of under-reporting examine the difference between police and hospital records but there may also be a large number of less-serious injuries sustained while bicycling which are not be recorded in hospital or police data, as no complaint or treatment was sought. Rider surveys provide an opportunity to measure the extent of under-reporting of bicycling injuries, particularly of less serious injuries. A lack of detailed exposure data [12], and the difficulty in estimating bicycle trips through secondary data (e.g. fuel sales can be used for motor vehicles) or inconsistent use of travel surveys between countries, makes the comparison of bicycle safety between jurisdictions difficult [36]. The current survey has been developed to collect exposure data, and with consistent exposure measures researchers will be able to make more accurate comparisons between jurisdictions.

The European Cooperation in Science and Technology, COST Action TU1101: Towards safer bicycling through optimization of bicycle helmets and usage, aims to increase scientific knowledge about bicycle helmets in regards to traffic safety and to disseminate this knowledge to stakeholders, including cyclists, legislators, manufacturers, and the scientific community. As part of this collaboration, Work Group 2 examines bicycle helmet safety with respect to traffic psychology. The Group includes researchers from Italy, Greece, Spain, France, Norway, the Netherlands, Portugal, United Kingdom, Turkey, Israel, and Australia. The two major outputs of Work Group 2 will be the current survey and a comprehensive literature review on bicycle helmets.

The Survey of Bicycle Use and Safety Perceptions has been designed to gain a greater understanding of bicycle and helmet use and crash involvement. The objectives of the survey are to develop (1) a tool to measure bicycle riders use and perceptions of helmets and (2) a core set of questions that could be used internationally. The results will establish a pan-European database, and include selected international data also (namely Israel and Australia), of bicycle crashes as well as behaviours and attitudes in regard to bicycle helmet use. The inclusion of data from Australia provides an interesting comparison with results from a country

where bicycle helmets have been mandatory for more than 20 years and where a substantial amount of early research regarding the effects of bicycle helmet legislation was conducted.

2 METHODOLOGY

2.1 Questionnaire

The questionnaire consists of 30 core items which are common across countries, and additional items which may have been included to suit the particular circumstances or issues in specific countries (e.g. riding in ice and snow). The first author is happy to provide a copy of the Australian version of the questionnaire upon email request (n.haworth@qut.edu.au).

The questionnaire commences with a screening question regarding whether the participant has ridden a bicycle in the last month (although this may differ slightly among countries). This is followed by 7 demographic items with response options taken from international surveys such as SARTRE surveys to allow the representativeness of the survey sample to be assessed. This is followed by 5 items regarding car licences and travel and access to cars and bicycles. There are then 9 questions that measure the frequency of cycling and amount of cycling for different purposes (e.g., commuting, health, recreation) and in different environments (e.g., bicycle trails, bike lanes, on sidewalks, in traffic). The following section comprises 5 questions on circumstances for use and non-use of helmets. There are then two questions about attitudes to bicycle use and attitudes to helmet use. Many of the constructs of the Theory of Planned Behaviour are incorporated into these items. The items were carefully worded to maximise the relevance and usefulness of information collected from both wearers and non-wearers of helmets. The final 2 questions collect information about crash involvement (including helmet use) and whether the crash was reported to the police.

The survey combines new scale items, and items from previous bicycle safety surveys developed by the collaborating researchers including the Queensland Cycling Survey [37], and earlier Greek questionnaires. The base questionnaire was developed in English and translated by researchers in each country. In each country the translated version was then translated again to English to correct any misappropriate translations. The software used to administer the online questionnaire has varied between countries, with KeySurvey being used in a range of countries. The Dutch Institute for Road Safety Research (SWOV) has assisted in programming the survey in several languages.

2.2 Participant recruitment

Convenience sampling via social media, word-of-mouth, and bicycle organisations is the primary recruitment strategy because of lack of funding for the study. Participants were restricted to adults (18 years old or older) who had ridden a bicycle in the last month.

2.3 Data collection and analysis

As at 30 October 2014, data collection has been completed in Israel, Italy and Norway, is underway in Greece, Australia and France, and is yet to commence in Croatia, Denmark, Germany, Portugal, Romania, Spain, Turkey, and United Kingdom. The goal is to complete all data collection before the winter season sets in and riding patterns change (especially in Northern countries). The data will be shared when data collection from all countries is completed.

3 ISRAEL AS A CASE STUDY: Method and Preliminary Results

3.1 Background and method

The first piloting occurred in Israel, where cycling has recently become popular as a hobby and a mean of transportation, but without sufficient cycling infrastructure or regulations related to cycling and cycling culture. Data collection and initial analysis was conducted by two senior Industrial Engineering students as part of their final project. The English questionnaire was translated to Hebrew and back to English by independent translators and the final translation was compared to the original. Discrepancies were eliminated through revisions in the Hebrew version. A pilot survey was conducted in person on five bicycle riders. Participants were recruited through personal contacts, social networks, bicycle riding clubs, and through stickers with barcodes posted on bus stations and billboards on campus and off campus directing respondents to the online questionnaire (see Figure 1). All respondents were directed to a dedicated site of SurveyGismo where they filled out the online interactive questionnaire in Hebrew. A total of 315 people filled out the survey, but 48 were eliminated from the data analyses (either because they were under 18, or because they rode less than 1km per week on the average). However, because not all questions were relevant to all respondents, N is not 267 for all questions. The convenience sample of 267 riders consisted of 76% males; 40% 18-30 years old, 42% 31-49 years old, 14% 50-59 years old, and 5% 60 years old or older.

Figure 1. Sticker attached to various locations on University campus, train stations, bus stations etc., requesting bicyclists to participate in a survey that "could help improve bicycling infrastructure and safety"

3.2 Preliminary Results and Discussion

In terms of occupation, the largest group was students (32%), followed by independent professionals (27%), and closely followed by salaried employees (24%). There was a significant positive correlation between age and the amount of riding (r=.30), with older participants riding more often. Interestingly there was also a positive correlation between the reported amount of car driving and the amount of riding (Spearman's rho = 0.25). In addition, 52% of those who did not own a car rode daily or almost daily, whereas of those who did own a car only 19% reported riding daily or almost daily (χ^2= 25.25, p<.001). Thus the relationship between driving and bicycle riding is not a simple one of one substituting for the other.

People ride bicycles for different reasons. The questionnaire provided several reasons, and the respondents had to estimate the number of km they rode for each purpose per week. The reasons were: to work/school (24 km), as part of work, shopping/chores (9 km), to social gatherings, for pleasure (15 km), for health/sport (45 km). Thus respondents used a bicycle as

an exercise machine more than as a means of mobility, and this trend increased with age (see Figure 2). Furthermore, this trend depended of the person's socio-economic status: the higher it was, the more frequent the bicycle was used for health/sport (Figure 3). Obviously age and socio-economic status are correlated.

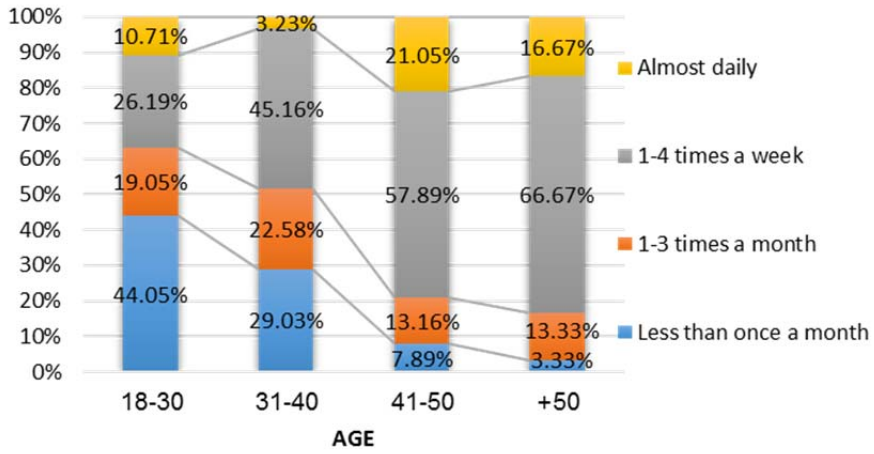

Figure 2. Frequency of bicycling for health/sports reasons as a function of age

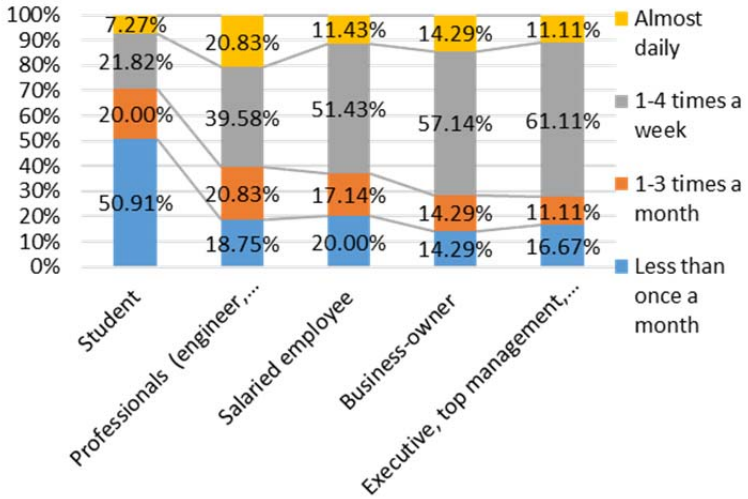

Figure 3. Frequency of cycling for health/sports reason as a function of occupation

Helmet use is not a requirement in Israel for riders over 18 years old but many people use helmets, especially for sport riding on inter-urban roads. In our sample 74% of the respondents said they owned a helmet. There was a correlation between the amount of riding and use of helmets (Spearman's Rho = 0.55). People who said that they never use a helmet rode on the average 16 km/week, and those who used it "nearly always or always" rode an average of 98 km/week (Figure 4). Helmet use was also strongly associated with age: nearly all (>90%) of mature and older people (40+) nearly always or always used a helmet, whereas for riders under 30 years old this was true only for 31% (ρ=0.58). As might be expected, there was an association between the beliefs about helmet's benefits (based on answers to three questions: riders who do not use them increase their risk, helmets reduce cyclists fatalities, and helmets reduce severe head injuries) and frequency of use: 75% of those with a positive attitude used it always or nearly always, compared to 17% of those with a negative attitude (ρ=.43). Similarly,

those who wore a helmet frequently were less bothered by its negative aspects (sweating and discomfort, ruined hairstyle, and interference with head movements) than those who did not wear one regularly (ρ=-.48, -.45, -.56, respectively). A logistic regression on the variables that contribute to the prediction of helmet use yielded four significant variables: (1) Gender- females were more likely to wear a helmet (2) Child passengers – carrying children increased the likelihood of using a helmet, (3) Average riding distance – the greater the distance the more likely a rider was to use a helmet, and (4) Comfort – the more the rider agreed that the helmet use was uncomfortable, the less likely he/she were to use it.

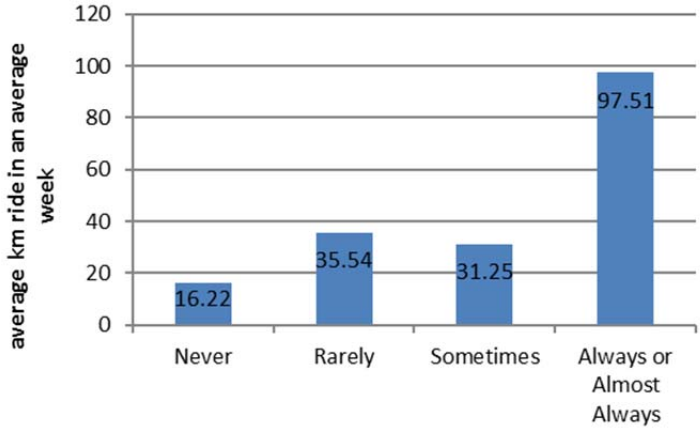

Figure 4. Average number of km ridden per week as a function of frequency of helmet use

Bicycle crashes are notoriously under-reported in police data. Consequently our knowledge of factors associated with cyclists' crash involvement is quite poor. In the survey 20% of the respondents said that they had been involved at least once in a crash as a cyclist (58 crashes), and none of these crashes were reported to the police. Although 73% of these reported crashes did not require professional medical treatment, 11% actually involved referrals to the hospital for ambulatory treatment. In addition, 36% of the respondents were aware of bicycle crashes of others that they knew, totaling 89 crashes. Of these crashes and the ones that they had themselves, 50% were from a fall from the bicycle and only 13% were from a collision with a motor-vehicle (Figure 5). For all crash types, over 50% involved minor injuries, but 24% of the falls, 24% of the collisions with other cyclists, and 31% of the collisions with a motor vehicle involved hospital referrals. There were no significant differences in crash involvements between males and females, but age was a significant factor, with riders 30 years old or younger being involved in more crashes than older ones ($\chi^2(1)= 66$, $p=.006$). The effect of exposure on crash involvement was somewhat unexpected. Those who reported riding less than 10 km/week were the least involved (6%). However, beyond that minimum level, exposure had no effect and regardless of km/week of riding crash involvement varied from 22% to 31% in a manner that was unrelated to exposure. Decreasing crash rates with increasing exposure has been reported in other surveys [38]. Crash involvement was apparently not a sufficient incentive to wear helmets. Of those who did not wear a helmet when they had the crash, 89% felt that wearing a helmet would not have reduced their head injuries. On the other hand, when all crashes were considered (to themselves and their friends), regarding those who wore a helmet, 79% of the respondents felt that it reduced the head injuries. Finally, in our sample approximately half the respondents (53%) said they listen to music or talk on the phone while riding. Of those, 11% reported that they were involved in a crash *because* they were distracted by the music or the conversation.

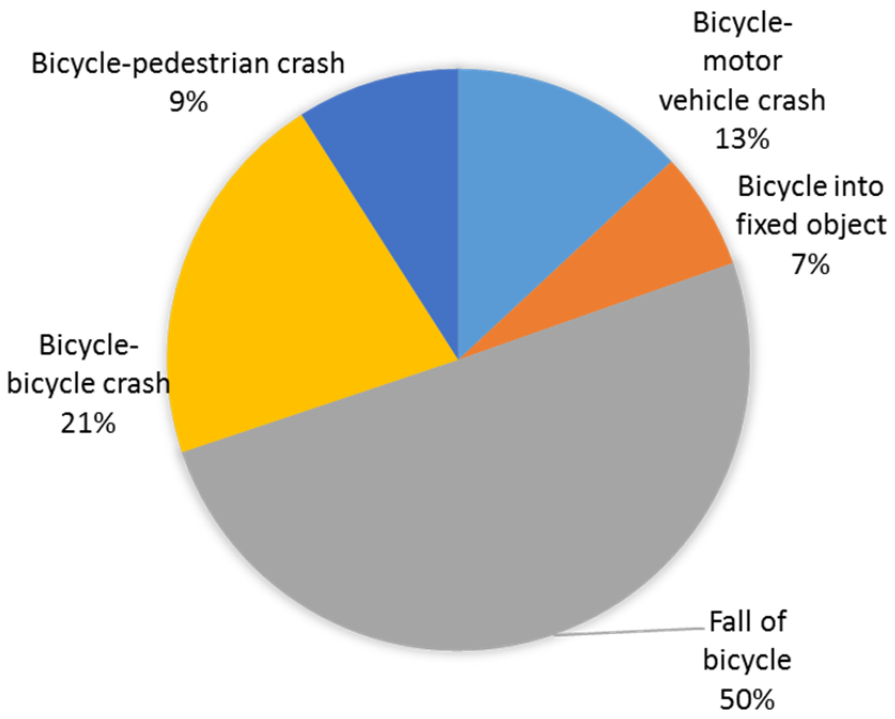

Figure 5. Distribution of bicycle crashes by type.

The final issue addressed in the survey was knowledge of rules of the road (non-core questionnaire items). Because bicyclists are not licensed, and because rules of the road are rarely enforced on them, it is considered in Israel that they are much more likely to commit serious traffic violations. In our survey only 31% responded that they always adhere to the rules of the road, whereas 21% said that they do that occasionally. In general, there was a positive association between perceived knowledge of rules of the road and adherence to them (ρ=.34). However, when asked specifically about the helmet laws in Israel, there was no relationship between knowledge of the law and perceived knowledge of the traffic regulations. Less than 3% knew the law in full and approximately 50% did not know it at all, independently of the proclaimed level of knowledge.

3.3 Limitations

The survey used convenience sampling and this may have biased the sample towards people who are more interested in cycling. This might have inflated the estimates of frequency of use and led to fewer older riders being included. It would be useful to compare the characteristics of the current sample with the results obtained from population surveys. However, it could be argued that the cyclists who ride more (and are potentially over-represented in the sample) are the riders who have the most crashes (even if their rate per km is lower) and therefore they are of most interest to road safety in terms of their riding patterns and helmet use.

The survey did not collect detailed information about the crash circumstances. It would have been interesting to know the extent to which temporary (e.g. slippery surfaces or alcohol) or more permanent (e.g. rough surfaces, poor skills) contributed to the 50% of crashes that involved a fall from the bicycle.

The relatively small sample size in the Israeli pilot survey prevented disaggregation of the sample to better understand the differing characteristics of particular sub-groups (particularly transport and exercise riders). However, the data suggest that there is a complex relationship

between age, socioeconomic status, purpose of riding, distance ridden and helmet use (and attitudes) that should be explored when larger samples are collected.

3.4 Preliminary Conclusions

The Working Group was able to develop an international questionnaire to measure both bicycle and helmet usage and the individual demographic and attitudinal factors potentially underlying these behaviours, as well as crash involvement. The research method chosen in most countries was a comprehensive web-based survey on cycling and wearing helmets. The survey provided a first step in addressing the lack of data on cycling habits and wearing helmets of cyclists in Israel.

According to the survey findings there is a significant positive correlation between the amount of cycling and frequency of wearing bicycle helmets among riders. Also, 20% of the survey respondents (134) were involved in road crashes and 53% of them described their most serious crash as falling off the bike. However, none of these crashes were reported to the police. Therefore, the police database does not reliably represent non-fatal bicycle crash statistics in Israel. Also, only 1% of respondents were fully proficient in the helmets laws and 51% partially proficient.

While it is important to note that the sample of respondents to the survey was not representative of the entire population due to the limited distribution of the survey, the preliminary conclusions of the study can help us get a general idea of the character of cyclists in Israel and offer interesting and important topics for more systematic research.

Furthermore, once the data from across countries will be added to the database, the effects of additional cross-cultural and legislation factors can be examined.

REFERENCES

[1] Australian Bicycle Council, *Gearing up for active and sustainable communities*, Austroads, Sydney, 2010.

[2] Medibank Private, "The cost of physical inactivity", (2007).

[3] J. Stephenson, A. Bauman, T. Armstrong, B. Smith, B. Bellew, *The costs of illness attributable to physical inactivity in Australia. A preliminary study*, Report for Comm Department of Health and Aged Care and the Australian Sports Commission, 2000.

[4] L.B. Anderson, P. Schnohr, M. Schrool, H.O. Hein, "All-cause Mortality Associated with Physical Activity During Leisure Time, Work, Sports, and Cycling to Work", *Archives of Internal Medicine*, **160**, (2000), pp 1621-1628.

[5] J. de Hartog, "Do the Health Benefits of Cycling Outweigh the Risks? ", *Environmental Health Perspectives*, **118**, (2010), pp 1109-1116.

[6] I.J.M. Hendriksen, M. Simons, F. Garre, V.H. Hildebrandt, "The association between commuter cycling and sickness absence", *Preventive Medicine*, **51**, (2010), pp 132-135.

[7] E. Fishman, S. Washington, N. Haworth, "Understanding the fear of bicycle riding in Australia", *Journal of the Australiasian College of Road Safety*, **23**, (2012), pp 19-27.

[8] K.N. Ahlport, L. Linnan, A. Vaughn, K.R. Evenson, D.S. Ward, "Barriers to and Facilitators of Walking and Bicycling to School: Formative Results From the Non-Motorizezd Travel Study", *Health Education & Behaviour*, **35**, (2008), pp 221-224.

[9] M. Winters, G. Davidson, D. Kao, K. Teschke, "Motivators and deterrants of bicycling: comparing influences on decisions to ride", *Transportation* **38**, (2011), pp 153-168.

[10] H. Naci, D. Chisholm, T.D. Baker, "Distribution of road traffic deaths by road user group: a global comparison", *Injury Prevention*, **15**, (2009), pp 55-59.

[11] J. Pucher, L. Dijkstra, "Promoting safe walking and cyclingn to improve public health: lessons from The Netherlands and German", *American Journal of Public Health*, **93**, (2003), pp 1509-1516.

[12] OECD/ITF, *Cycling, Health and safety*, OECD Publishing/ITF, 2013.

[13] R.G. Poulos, J. Hatfield, C. Rissel, R. Grzebieta, A.S. McIntosh, "Exposure-based cycling crash, near miss and injury rates: the Safer Cycling Prospective Cohort Study protocol", *Injury Prevention*, **18**, (2012), pp e1.

[14] D.G. Lopez, D.L. Rosman, G.A. Jelinek, G.J. Wilkes, P.C. Sprivulis, "Complementing police road-crash records with trauma registry data - an initial evaluation", *Accident Analysis & Prevention*, **32**, (2000), pp 771-777.

[15] K. Veisten, K. Sælensminde, K. Alvær, T. Bjørnskau, R. Elvik, T. Schistad, B. Ytterstad, "Total cost of bicycle injuries in Norway, Correcting injury figures and indicating data needs", *Accident Analysis & Prevention*, **39**, (2007), pp 1162-1169.

[16] J.C. Stutts, J.E. Williamson, T. Whitley, F.C. Sheldon, "Bicycle accidents and injuries: A pilot study comparing hospital- and police-reported data", *Accident Analysis & Prevention*, **22**, (1990), pp 67-78.

[17] J.D. Langley, N. Dow, S. Stephenson, K. Kypri, "Missing cyclists", *Injury Prevention*, **9**, (2003), pp 376-379.

[18] J. Pucher, R. Buehler, "Cycling for Everyone Lessons from Europe", *Transportation Research Record*, **2074**, (2008), pp 58-65.

[19] J. Pucher, R. Buehler, "Cycling for Everyone Lessons from Europe", *Transportation Research Record: Journal of the Transportation Research Board*, **2074**, (2008), pp 58.

[20] J. Garrard, S. Crawford, N. Hakman, *Revolutions for Women: Increasing women's participation in cycling for recreation and transport*, Deakin University School of Health and Social Development, Burwood, 2006.

[21] J. Garrard, Rose, G., & Kai, L. S. , "Promoting transportation cycling for women: The role of bicycle infrastructure", *Preventive Medicine*, **46**, (2008), pp 55 -59.

[22] T. Özkan, T. Lajunen, J.E. Chliaoutakis, D. Parker, H. Summala, "Cross-cultural differences in driving behaviours: A comparison of six countries", *Transportation Research Part F: Traffic Psychology and Behaviour*, **9**, (2006), pp 227-242.

[23] R.G. Attewell, K. Glase, M. McFadden, "Bicycle helmet efficacy: a meta-analysis", *Accident Analysis & Prevention*, **33**, (2012), pp 345-352.

[24] K.S. Klein, D. Thompson, P.C. Scheidt, M.D. Overpeck, L.A. Gross, "Factors associated with bicycle helmet use among young adolescents in a multinational sample", *Injury Prevention*, **11**, (2005), pp 288-293.

[25] G.B. Rogers, "Effects of state helmet laws on bicycle helmet use by children and adolescents", *Injury Prevention*, **8**, (2002), pp 42-46.

[26] S. Harlos, L. Warda, N. Buchan, T.P. Klassen, V.L. Koop, M.E.K. Moffatt, "Urban and rural patterns of bicycle helmet use: factors predicting usage", *Injury Prevention*, **5**, (1999), pp 183-188.

[27] J. Gilchrist, R.A. Schieber, S. Leadbetter, S.C. Davidson, "Police Enforcement as Part of a Comprehensive Bicycle Helmet Program", *Pediatrics*, **106**, (2000), pp 6-9.

[28] J. Ritter, C. Vance, "The determinants of bicycle helmet use: Evidence from Germany", *Accident Analysis & Prevention*, **43**, (2011), pp 95-100.

[29] J.S. Osberg, S.C. Stiles, O.K. Asare, "Bicycle safety behaviour in Paris and Boston", *Accident Analysis & Prevention*, **30**, (1998), pp 679-687.

[30] M.H. Cameron, A.P. Vulcan, C.F. Finch, S.V. Newstead, "Mandatory bicycle helmet use following a decade of helmet promotion in Victoria Australia - and evaluation", *Accident Analysis & Prevention*, **26**, (1994), pp 325-337.

[31] N. Haworth, A. Schramm, "Interactions between pedestrians and cyclists in the city centre", in: *Asia-Pacific Cycling Congress*, Brisbane, Australia, 18-21 September 2011, 2011.

[32] M. Karkhaneh, J.-C. Kalenga, B.E. Hagel, B.H. Rowe, "Effectiveness of bicycle helmet legislation to increase helmet use: a systematic review", *Injury Prevention*, **12**, (2006), pp 76-82.

[33] J.T. Finnoff, E.R. Laskowski, K.L. .Altman, N.N. Diehl, "Barriers to Bicycle Helmet Use", *Pediatrics*, **108**, (2001), pp e4.

[34] P. Berg, R. Westerling, "Bicycle helmet use among schoolchildren - the influence of parental involvement and children's attitudes", *Injury Prevention*, **7**, (2001), pp 218-222.

[35] C.F. Finch, "Teenagers' attitudes towards bicycle helmets three years after the introduction of mandatory wearing", *Injury Prevention*, **2**, (1996), pp 126-130.

[36] A.S. Hakkert, L. Braimaister, *The use of exposure and risk in road safety studies*, SWOV, Leidschendam, 2002.

[37] N. Haworth, A. Schramm, "How Do Level of Experience, Purpose for Riding, and Preference for facilities Affect Location of Riding? Study of Adult Bicycle Riders in Queensland, Australia", *Transportation Research Record*, **2247** (2011), pp 17 - 23.

[38] S. Washington, N. Haworth, A. Schramm, "Relationships Between Self-Reported Bicycling Injuries and Perceived Risk of Cyclists in Queensland, Australia", *Transportation Research Record*, **2314** (2012), pp 57 - 65.