Risk Factors and Pattern of Injuries in Motorcycle Accidents in Holy Karbala

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Abstract

Background: Worldwide, the morbidity and mortality among motorcyclists involved in road traffic accidents is high. In Iraq, since 2003, there have been an increasing number of motorcycles in the streets; this phenomenon was particularly noticed in the Province of Holy Karbala.
Objective: To shed light on the risk factors and pattern of injuries in motorcycle accidents in Holy Karbala.
Design: Hospital-based cross-sectional, study.
Setting: Al-Husain teaching hospital in Holy Karbala in Iraq, from 7th November 2010 to 17th February 2011.
Patients and Methods: This study involved all injured motorcyclists involved in road traffic accidents who were admitted to the emergency department and their mortalities which were referred to the medico-legal department (N=456). The information collected included personal identification data, the person's position on the motorcycle during the event, in addition, the type and site of injury and the outcome of the victims were reported.
Results: The mean age (± standard deviation) of the subjects was (24 ± 10.12 years); More than one quarter (25.7%) of the injured motorcyclists (26.1% of drivers and 22.7% of pillion passengers) were within 15-19 years of age. Most of the drivers (61.7%) had low level of education; 53.9% were smokers, 2.9% were alcoholics and 32.7% had history of previous accidents of whom 35 (11.5% of them) had more than one accident. The lower limb was the commonest site of injury (61.8% of patients); the upper limb and the head were the second and third leading site of injury (26.1 % and 23.7% respectively). About half of the patients (49.8%) complained of fractures. More than quarter of the cases (25.6%) needed admission to the wards or the intensive care unit. The case fatality rate was found to be 5%.
Conclusions: Teenagers motorcycle drivers are the most commonly affected category in motorcycle accidents. Lower limb injuries represent the commonest site and fractures represent the commonest form of injury among motorcyclists involved in road traffic accidents. A considerable proportion of cases need inpatient medical care. Head injuries were the predominant cause of deaths
Key words: Risk factors**;** injury pattern**;** motorcycle accidents; road traffic accidents; Holy Karbala

الخلاصة

الخلفية: إن معدلات الاعتلال والوفيات بين سائقي الدراجات النارية في حوادث المرور مرتفعة في عموم دول العالم. في العراق و منذ 2003، كان هناك عدد متزايد مِنْ الدراجات النارية في الطرق؛ هذه الظاهرةِ لوحظتْ بشكل خاص في محافظة كربلاء المقدّسة.
الهدف: تسليط الضوء على عوامل الخطورة ونمط اصابات حوادث الدراجات النارية في كربلاءالمقدّسة.
التصميم: دراسة مستعرضة، معتمدة على المستشفى.

إلمكان: مستشفى الحسين التعليمي في محافظة كربلاء المقدسة في العراق للمدة من 7 تشرين الثاني 2010 إلى 17 شباط 2011.

المرضى والأساليب: شملت الدراسة جميع راكبي الدراجات النارية المصابين بحوادث الطرقالمرورية الداخلين الى شعبة الطوارئ ووفياتهم التي احيلت إلى شعبة الطب العدلي بسبب تلك الحوادث (العدد=456). تضمنت البيانات التي تم جمعها معلومات سكانية عن المصاب ومكانه على الدراجة أثناء الحادث بالإضافة الى تشجيل نوع ومكان الإصابة ومصير الضحية.

النتائج: كان متوسط عمر المصابين (24 ± 10.12 سنة) وكان أكثر مِنْ الرُبْع (25.7 %) (26.1 % مِنْ السواق و22.7 % مِنْ مسافري المقعد الخلفي) كَانوا ضمن الفئه العمرية (15 - 19سنة) . أغلب السواق (61.7 %) كَانَ عِنْدَهُمْ مستوى منخفضُ مِنْ التعليم؛ 53.9 % كَانوا من المدخنين، 2.9 % كانوا من متناولي الكحول و32.7 % كَانَ عِنْدَهم تأريخُ لحوادثِ سابقةِ ومن ضمنهم 35 (11.5 % منهم) سبق ان تعرض لاكثر مِنْ حادث واحد. الطرف السفلي كَانَ الموقعَ الاكثر تعرضا للاصابة (61.8 % مِنْ المرضى)؛ يليه الطرف الأعلى والرأس (26.1 % و23.7 % على التوالي). حول نِصْفِ المرضى (49.8 %) إشتكى مِنْ الكسور.و أكثر مِنْ رُبْع مِنْ الحالاتِ (25.6 %) إحتاجَ الدخولَ إلى الردهاتِ أو وحدةِ العنايةِ المركّزةِ معدل الاماتة كان 5 %.

الاستنتاجات: الاصابات الناتجة عن حوادث الدراجات النارية هي الاكثر بين الشباب من سواق الدراجات النارية وكان المراهقون هم الفئة الاكثر تعرضا للحوادث. والطرفِ السفلي هو الأكثر تعرضا للاصابات. والكسور هي النوع الاكثر حدوثا ، وان نسبة كبيرة مِنْ الحالاتِ تَحتاجُ الى عناية طبية داخل المستشفى وان اصابات الرأس هي السبب الاغلب للوفيات.

مفتاح الكلمات: عوامل الخطورة، نمط الإصابات، حوادث الدراجات النارية، كربلاء المقدسة

Introduction

Worldwide road traffic accidents (RTAs) are the ninth leading cause of death and it is the sixth leading cause in middle income countries [1]; they are the leading cause of death among young people, aged 15–29 years; Over 90% of the world's fatalities on the roads occur in low-income and middle-income countries, even though these countries have less than half of the world's vehicles [2].In many countries, motorcycle collisions account for a considerable rate of morbidity and mortality due to traffic accidents [3-8]; Motorcyclists and pedestrians comprise the majority of road-traffic victims in low-income and middle-income countries[9,10]; and a major contributor to health care cost especially in the developing countries[3,7,10-12]. They make up more than 50% of those injured or killed on the roads [13]. A number of studies on motorcycle accidents have reported a high incidence of injuries, high injury severity scores, and high death rates [4, 14-15];

The number of motorcycles per inhabitant increased constantly in the last years in Asia, Africa and European countries [8]. Their small size and low weight are the important advantages of motorcycles, but being often missed by drivers of other larger vehicles and the rider has difficulty in controlling them, in particular when cornering or braking, are main documented disadvantages therefore they are associated with a high incidence of accidents with the consequent injuries, and death rates [3,8,12]; These accidents pose a tremendous burden to individuals and society [16].

In Iraq, since 2003, and because of socio-economic changes there has been an increasing development in the private transport sector in general and an increasing number of motorcycles; this phenomenon was particularly noticed in Holy Karbala which is the capital of Holy Karbala Governorate, and has an estimated population of 572,300 people [18].

Many reports from studies conducted outside Iraq have shown that both lower limb and head injuries appear to be common among motorcyclists, and young-adult males were the most commonly affected group [3,7,10,18].

This may be the first paper describing the epidemiology of motorcycle crashes resulting in death and hospitalization in Holy Karbala, for we failed to find previous similar literature. In order to shed light on the risk factors and pattern of injuries among motorcyclists, involved in

RTA in Holy Karbala, this study was conducted.

Patients and Methods

This cross-sectional hospital-based study was performed at Al-Husain teaching hospital in the Province of Holy Karbala in Iraq. The study involved all injured motorcyclists admitted to the emergency department and their mortalities which were referred to the medico-legal department because motorcycle accidents, from 7th November 2010 to 17th February 2011 (N=456; mean age 24 ± SD 10.12 years); Twelve non-traffic accidents caused by motorcycle (e.g. during maintenance or terrorist explosive attacks) were not included in the study.

A questionnaire specially designed for this purpose was used for interviewing the injured subjects or their attendants when their condition did not warrant the interview. The information collected consisted of personal identification data and the person's position on the motorcycle during the accident; in addition, the type and site of injury and the outcome of the case were reported.

For the purpose of the study, a motorcycle accident was defined as a RTA involving a motorcycle; the personal status during accident was identified whether he was the driver or pillion-passenger; the site of injury at any body-regions including the head, neck, trunk (chest, abdomen and pelvis), upper limb, and lower limb was also identified; in addition, injuries were classified into four categories (simple skin contusion and ecchymosis (any blunt traumatic lesion to skin), soft tissue wound (traumatic open lesion to skin, subcutaneous, muscular, connective tissues), fracture (confirmed by radiography), and vascular injury). The fate of the subject whether he was discharged in good condition (or on his responsibility), Admitted to the wards or intensive care unit (ICU), or died. The approximate life expectancy for Iraqi population (both sexes combined)) of 66, (according to the world health organization (WHO) [20]), was used when calculating the Potential Years of Life Lost (PYLL) (the total number of years not lived by an individual who died before the age of approximate life expectancy) as (66 – age at death) The PYLL for all deaths was calculated as the sums the individual PYLLs [21]. The case fatality rate (CFR) (percentage of the injured motorcyclists who died because of the injury) was also calculated.

Data management and statistical analysis was done using the Statistical Package for Social Sciences (SPSS) version 16.0 software. Pearson Chi-Square (x2) was used to determine whether there is a relationship between categorical variables and Odds Ratio (OR) was used in assessment of the risk. All statistical analysis was done at 95% confidence level. Statistical significance was accepted when $P< 0.05$.

Results

During the 102 days period of the study 456 motorcyclists were hospitalized giving an incidence rate of 22.6 per 100,000 persons; they were 430 (94.3%) males and 26 (5.7%) females. Their mean age was 24 ± SD 10.12 years (range 3-56 years); one quarter of the victims were 15-19 years of age. Three hundred and six subjects (67.1%) were motorcycle drivers (9-56 years of age) and 150 (32.9%) were pillion passengers (3-55 years of age). All the drivers except one (99.7%) were males, while 125 (83.3%) pillion passengers were males and 25 (16.7%) were females

The highest percentage of the injured motorcyclists (25.0%) were within 15-19 years of age, (26.1% of the drivers and 22.7% of the pillion passengers); Table 1 shows that the highest rate (32.7%) of injured drivers was below 20 years of age, and this rate decreases within advancing age groups and the highest percent of the

pillion passengers (28%) were below 15 years of age.

Table1: Frequency distribution of subjects by person's position on the motorcycle and age

Person's position	Age group (years)							Total
	<15	15-19	20-24	25-29	30-34	35-39	≥40	
Motorcycle drivers (N=306)	20 (6.5%)	80 (26.1%)	53 (17.3%)	52 (17.0%)	51 (16.7%)	29 (9.5%)	21 (6.9%)	306* (100%)
Pillion passengers (N=150)	42 (28.0%)	34 (22.7%)	22 (14.7%)	15 (10.0%)	14 (9.3%)	5 (3.3%)	18 (12%)	150 (100%)
Total (N=456)	62 (13.6%)	114 (25.0%)	75 (16.4%)	67 (14.7%)	65 (14.3%)	34 (7.5%)	39 (8.6%)	456 (100%)

* X^2 = 43.7264, df = 6; P< 0.001

Most of the drivers (61.7%) had low level of education (primary school and less); 53.9% were smokers, nine (2.9%) claimed alcohol consumption (none of them was drinker at the time of examination) and 32.7% had history of previous accidents of whom 35 (11.5% of all the drivers) had more than one accident; none of the study subjects used to use the protective devices. The frequency distribution of the drivers according to their education, smoking habit, alcohol consumption and history of previous accidents is presented in Table 2.

Table 2: Distribution of the drivers according to education, smoking habit, alcohol consumption and history of previous accidents

Variable	N	Percent
Education		
<Primary school	23	7.5
Primary school	166	54.2
Secondary school	105	34.3
University	7	2.3
Missing	5	1.6
Smoking habit		
Smoker	165	53.9
Non smoker	137	44.8
Missing	4	1.3
Alcohol drinking		
Yes	9	2.9
No	293	95.8
Previous accident		
Yes	100	32.7
No	200	65.4
Missing	6	2.0
Total	306	100.0

The lower limb was the commonest site of injury the upper limb and the head were the second and third leading site of injury respectively. The distribution of injuries according to the site is represented in Table 3. The difference in the total observed is due to the fact that 97 (21 %) of the study subjects had injuries at more than one anatomical body-region.

Table 3: Distribution of injuries according to site

Site of injury	No. of patients	Percent*
Head	108	23.7
Neck	14	3.1
Trunk	30	6.6
Upper limb	119	26.1
Lower limb	282	61.8
Total	553	-

*percent from the total number of study subjects

About half of the study subjects complained of fractures and about quarter had vascular injuries; Table 4 shows the frequency distribution of injuries according to their type, The difference in the total observed is due to the fact that 164 (36 %) of the study subjects had more than one type of injury.

Table 4: Distribution of injuries according to type

Type of lesion	No. of patients	Percent*
Contusion and/or ecchymosis	172	37.7
Soft tissue wound	255	55.9
Fracture	227	49.8
Vascular injury	23	5.0
Others	6	1.3
Total	683	-

*percent from the total number of patients

More than quarter of the cases (25.6%) needed admission (24.1% to the wards and 1.5% the intensive care unit (ICU)). The Frequency distribution of the cases according to their fate is shown in Table 5.

Table 5: Frequency distribution of study subjects according to the fate

Fate of the patient	Frequency	Percent
Discharged in good condition	252	55.3
Admitted to the wards	110	24.1
Admitted to the ICU	7	1.5
Discharged on his responsibility	64	14.0
Death	23	5.0
Total	456	100

For the period of the study, 23 fatalities were identified resulting in a mortality rate of 1.1 per 100,000 persons; They were 21 males with mean age of 27.05± SD 11.142 and 2 females with mean age of 12.50 ± SD 0.707. More than one third (34.8%) of deaths were below 20 years of age; PYLL for the victims was found to be 925 years. The CFR was 5%. Seventeen (73.9%) were drivers and 6 (26.1%) were pillion passengers. Seventeen of the deaths (73.9%) were due to head injury.

Discussion

The hospitalization rate of motorcyclist's injuries concluded in this study, which is 4 folds that reported in a series of three papers describing the epidemiology of motorcycle crashes resulting in death and hospitalization in New Zealand, point out

to the high magnitude of the problem in Holy Karbala city [7,22].

The higher incidence of motorcycle accidents among males concluded in our study in consistent with the findings of other previous studies in other countries [3, 9, 13,16].

The high morbidity rate among younger age groups is in accordance with that concluded by Lin and, Kraus (2009) in their review of 220 articles on of risk factors and patterns of motorcycle injuries papers published in developing countries from January1980 to August 2008 and that of Begg et al (1994) [4,22].

The average age of the injured motorcyclists in our study is lower than that concluded by similar studies in Nigeria, Germany, Tehran and Singapore (36.4, 28.8, 28.11 and 26.4 years respectively)[3,10,13,16]; which could be attributed to the fact that, in our country, adolescence and even children are not prohibited from driving motorcycles and, even, more than two motorcyclists (riding one motorcycle, mostly young adults and children) are allowed. The majority of the injured motorcyclists (77.6%) were 15-39 years of age, which is the important productive age group; this adds a tremendous burden on the family and the society. The high morbidity rate among younger age groups is in accordance with that concluded by Lin and, Kraus in their review of 220 articles on of risk factors and patterns of motorcycle injuries papers published from January1980 to August 2008 and that of Begg et al (1994)[4,22].

The declining trend of the incidence rate with advancing age within the drivers encountered in our study is similar to that concluded by Mullin et al (2000) in New Zealand and Lin et al (2003) in Taiwan but it is different from that concluded by Tomida et al 2005 in Japan who concluded that there was no significant correlation between risk of injury and age [15,23,24]; this can be attributed to the fact that in our culture carelessness and risk taking behaviour during driving, not only motorcycles but even cars, is more the younger the driver is. The highest rate of injured drivers who are teenagers concluded in this study is similar to that of previous studies in New Zealand and Mazandaran Province in Iran [23, 25]. They are in accordance with the two explanations for the over presentation of young traffic participants in accidents the so called "beginner risk" and "youth risk" which explained the relation of age and accidents [8, 16]. Rutter and Quine (1998) in UK found that age played a much greater role than inexperience in explaining why young age groups are over-represented in casualty statistics[27].

The prevalence of pillion passengers among injured motorcyclist concluded in our study (32.9%) is considerably higher than that concluded by similar previous studies by Begg et al (1994) in New Zealand and Zargar et al (1999-2000) in Tehran (12% and 5.6% respectively)[13,22]; this could be explained by the fact that even more than one pillion passenger were often seen riding with the driver the highest percent were below 15 years of age .The considerable percent of females as pillion passengers concluded could be attributed on the basis of the increasing needs of easy accessible transport only.

Having a low level of education has been identified to be a risk factor in accidents; the low level of education encountered among most of the drivers concluded in this study is in accordance with similar but higher than that seen in a study by Iribhogbe and Odai (2006) in Benin City in Nigeria 2009 which was (52.8%) [11]. Therefore, at least and as Swaddiwudhipong et al (1995) concluded in their study in Thailand, Motorcycle rider education may be a promising intervention for prevention of motorcycle-related injuries [28].

More than half of the injured drivers were a current cigarette smokers, such high rate can be explained on socio-economic basis; Al-Ghabban (2009) in his study among students in university of Karbala (age

range 17-28 years) found that the prevalence of current smokers among male students was 33.4% [29].

In our study the prevalence within the same age group was found to be 54.6% (77 smokers out of 141 motorcycle drivers within this age group). Comparing the two groups, it was found that our prevalence is significantly higher than that in the Al-Ghabban study (P<0.05; OR=1.64), therefore, it can be concluded that smoking or else socio-economic factor might play a role as a risk factor contributing in such accidents

The high percentage of cases with history of previous accident is in accordance with the theory of "Accident-proneness" which was related to such factors as absent-mindedness, clumsiness, carelessness, impulsivity, predisposition to risk-taking, and unconscious desires to create accidents as a way of achieving secondary gains [30]; most of those factors seems to play a major role within the young age groups in our society.

High rates of helmet use among motorcyclists were found in studies in Singapore, Germany and New Zealand (100%, 98.8% and 83%respectively) [3,9,!7]; Helmet use was noted by Zargar et al (2000) in only 8.6% of cases in Tehran [13]; Iribhogbe and Odai (2006), in their study in Benin City, Nigeria, found that motorcyclists did not use Crash helmets on a regular basis. No study with similar results to ours could be found [11].

Similar to the results found in this study, the predominated lower limb injuries among motorcyclists was also found in our study in studies from New Zealand, Singapore, Tehran, Germany, Malaysia and Nigeria representing developed as well as developing countries[3,7,13,16-17,19,31-32] some of them reported head injuries as the second common anatomical site affected [3, 7,13, 16]. The non- wearing of special leg protective footwear by both motorcyclists and pillion passengers might be important factors contributing to the higher risk of lower limb injuries.

Our result is consistent with the results concluded by previous studies that showed that limbs injuries caused by motorcycle accidents are a major cause of morbidity and the long time spent in hospital [33].

In this study fractures represented the commonest injury seen; similar results were previously seen in studies performed elsewhere [3, 13, 17, 19,32].Closed fractures were commoner than the open fractures, which is consistent with the results concluded by Kortor et al (2007) in Nigeria [32].

Although most of those who were discharged from the hospital were complaining of mild soft tissue injuries requiring first aid measures only and the patient were discharged without admission, some of them were discharged according to their request and on their responsibility (which was because of medico-legal reasons); they used to be admitted to private hospitals later. Our study showed that one quarter of our patients needed admission to either the ward or ICU and they constituted a considerable proportion of bed occupancy.

The mortality rate concluded in this study is, similar to that of the incidence rate of injuries, 4 folds that concluded by Langley et al (1994) and that of Begg et al (1994), both in New Zealand (3.5 and 3.6 per 100,000 respectively) [7,22]; this might be an indicator of the seriousness of the injuries in Holy Karbala city and the importance of actions to be taken to limit such mortalities.

Motorcyclists in our study have more than 9 fold increased risk of being killed compared with those observed in Singapore 2002 and more than twice that of Zargar et al (200) in Tehran (Fatality rate= 0.62% and 2.1% respectively) which can be attributed to the non-use of helmet [3,13]; but it was similar to that concluded by Langley et al (1994) in New Zealand (5.3%) [7].

The highest mortality was within younger age groups is in accordance with that concluded by Langley et al (1994) and Lin

and, Kraus (2009) [4,7]; and similar to that of Begg (1994) and Lin and Kraus (2009), Males, especially those 15-24 years of age were the most commonly affected group of victims [7,22].

Drivers were the victims in about three quarters of fatalities; higher percent (88%) were reported by Begg et al (1994) in New Zealand [22]. This difference can be explained by the fact that more than one pillion passenger were often seen riding on one motorcycle in our city and, accordingly, the high proportion of pillion passengers in our study.

While lower-extremity injuries most commonly occur in all motorcycle crashes, head injuries are most frequent in fatal crashes, which is consistent with the results of Lin and Kraus review of 220 articles (2009) [4]; contributing to about three quarters of all motorcycle deaths which is higher than that mentioned by Kraus (1989) as about one-half of all motorcycle deaths [24]. This can be attributed to the non use of helmets among our motorcyclists. Helmets and helmet use laws have been shown to be effective in reducing head injuries and deaths from motorcycle crashes [4]; helmet use for both motorcyclists and their pillion riders have been mandatory in Singapore since 1971 [3]; and motorcycle fatalities decreased 14% after the introduction of the mandatory motorcycle helmet law in Taiwan and head injury fatalities fell 22% [34]; and Ankarath et al (2002) in UK proved that the injury severity were three times higher among those who did not wear the helmet [5]. Helmets could considerably reduce motorcycle crash related injury and death was also concluded by Wells et al (2004) in New Zealand [35].

A mandatory helmet law does not currently exist in Kerbala; Helmet use is strongly advocated and national mandatory helmet use law is clearly needed to reduce mortality associated with riding motorcycles.

The PYLL among the victims within the short period of the study pointed out to the importance of this issue and the importance of the preventive and control measures to limit its consequences.

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References

1. World Health Organization, The global burden of disease. 2004 update. Available at: http://www.who.int/healthinfo/global_burden_disease/2004_report_update/en/index.html. Accessed: 16 May 2011.
2. World Health Organization, Media Centre Road traffic injuries. Available at: http://www.who.int/mediacentre/factsheets/fs358/en/. Accessed in 3 October 2012
3. Lateef F. Riding motorcycles: is it a lower limb hazard? *Singapore Med J* 2002; 43 (11): 566- 9.
4. Lin MR and Kraus JF. A review of risk factors and patterns of motorcycle injuries. *Accident Analysis and Prevention* 2009; 41(4): 710–22.
5. Ankarath S, Giannoudis PV, Barlow I, Bellamy MC, Matthews SJ and Smith RM.. Injury patterns associated with mortality following motorcycle crashes. *Injury* 2002; 33(6):473–7.
6. Preusser DF, Williams AF and Ulmer RG. Analysis of fatal motorcycle crashes: crash typing. *Accident; analysis and prevention* 1995, 27(6):845–51.
7. Langley JD, Begga DJ and Reeder AI. Motorcycle crashes resulting in death and hospitalization. II: Traffic crashes. *Accident Analysis & Prevention* 1994; 26(2): 165-71.
8. Noordzij PC, Forke E, Brendicke R and Chinn BP. Integration of needs of moped and motorcycle riders into safety measures, Review and statistical analysis in the framework of the European research project PROMISING, Work

package 3. Leidschendam (2001), SWOV Institute for Road Safety Research, The Netherlands
9. Reeder AI, Chalmers DJ and Langley JD. Motorcycling attitudes and behaviours. I. 12and 13 year old adolescents. *JPaediatr Child Health* 1992; 28(3): 225-30.
10. Ameratunga S, Hijar M and Norton R. Road-traffic injuries: confronting disparities to address a global-health problem. *Lancet* 2006; 367: 1533–40
11. Iribhogbe PE and Odai ED. Related Risk Factors in Commercial Motorcycle (Okada) Crashes in Benin City, Nigeria. *Prehosp Disaster Med* 2009; 24(4): 356–9.
12. Al-Habdan IM, Sadat-Ali M, Al-Othman AA and Al-Awad NI. Injuries due to motorcycle accidents amongst Saudi women. Are we waiting for a new epidemic? *Saudi Medical Journal* 2000; 20(6): 458-60.
13. Zargar M, Khaji A and Karbaksh M. Pattern of motorcycle-related injuries in Tehran, 1999 to 2000: a study in 6 hospitals. *Eastern Mediterranean Health Journal* 2006; 12(1/2): 81-7.
14. World Health Organization, Media Centre. Helmet use saves lives. Available at: http://www.who.int/mediacentre/news/releases /2006/pr44/en/. Accessed 3 October 2012.
15. Tomida Y, Hirata H, Fukuda A, Tsujii M, Kato K, Fujisawa K and Uchida A. Injuries in elite motorcycle racing in Japan. *Br J Sports Med* 2005; 39: 508–11.
16. Segui-Gomez M and Lopez-Valdes FJ. Recognizing the importance of injury in other policy forums: the case of motorcycle licensing policy in Spain. *Inj Prev* 2007; 13(6): 429–30.
17. Wick M, Müller EJ, EkkernkampA and Muhr G. The motorcyclist: Easy rider or easy victim? An analysis of motorcycle accidents in Germany. *The American Journal of Emergency Medicine* 1998; 16(3): 320-3.
18. Wikipedia. The free encyclopedia. Karbala. Available at: http://en.wikipedia.org/wiki/Karbala. Accessed: 30 September 2012
19. Clarke JA and Langley JD. Disablement resulting from motorcycle crashes. *Disabil Rehabil* 1995; 17(7): 377-85.
20. WHO, Global Health Observatory (GHO). Iraq: country profiles. General health statistical profile. Available at: http://www.who.int/gho/countries/irq/country_ profiles/en/index.html. Accessed: May 19, 2011
21. Wikipedia, the free encyclopedia. Years of potential life lost. Available at: http://en.wikipedia.org/wiki/Potential_years_of _life_lost. Accessed: 13 September 2012
22. Begg DJ, Langley JD and Reeder AI. Motorcycle crashes in New Zealand resulting in death and hospitalization. I: Introduction, Methods and Overview. *Accid Anal Prev* 1994; 26(2):157-64.
23. Mullin B, Jackson R, Langley J and Norton R. Increasing age and experience: are both protective against motorcycle injury? A case-control study. *Inj Prev* 2000; 6(1):32-5
24. Lin MR, Chang SH, Pai L and Keyl PM. A longitudinal study of risk factors for motorcycle crashes among junior college students in Taiwan. *Accid Anal Prev*. 2003; 35(2):243-52.
25. Janmohammadi N, Pourhossein M and Hashemi SR. Pattern of Motorcyclist's Mortality in Mazandran Province, Northern Iran. *Iranian Red Crescent Medical Journal* 2009; 11(1):81-4
26. Kraus,J.F. Epidemiology of head injury. In: Cooper P.R. Head Injury, 2nd ed. Williams & Wilkins, Baltimore, MD 1989; 1–19
27. Rutter DR, Quine L and Albery IP. Perceptions of risk in motorcyclists: unrealistic optimism, relative realism and predictions of behaviour. *Br J Psychol.* 1998; 89(4): 681-96.
28. Swaddiwudhipong W, Boonmak C, Nguntra P and Mahasakpan P. Effect of motorcycle rider education on changes in risk behaviours and motorcycle-related injuries in rural Thailand. *Trop Med Int Health* 1998; 3(10):767-70
29. Al-Ghabban SI. Prevalence of current smoking among students in university of Kerbala. *Karbala Medical Journal*.2009; 2(8,9):645-61
30. Wikipedia, the free encyclopedia, Accident-proneness, Available at: http://en.wikipedia.org/wiki/Accident-proneness, accessed at: 4 May 2013
31. How CK, Megat Ahmad MM, Radin Umar RS, Hamouda AM and Harwant S. Crash simulation of lower limb with motorcycle basket. *Med J Malaysia* 2001; 56(1):77-81
32. Kortor JN, Yinusa W and Ugbeye ME. Lower Limb Injuries Arising From Motorcycle Crashes. *Nigerian Journal of Medicine journal of the National Association of Resident Doctors of Nigeria* 2010; 19(4) : 475-8
33. Craiq GR, Sleet R and Wood SK. Lower limb injuries in motorcycle accidents. *Injury* 1983; 15(3):163-6.
34. Tsai MC and Hemenway D. Effect of the mandatory helmet law in Taiwan. *Injury prevention*, 1999, 5(4):290–1.
35. Wells S, Mullin B, Norton R, Langley J, Connor J, Lay-Yee R and Jackson R. Motorcycle rider conspicuity and crash related injury: case-control study. *BMJ.* 2004; 328(7444):857-66