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Helmet Wearing and Traumatic Brain Injuries Among Motorcyclists in Cotonou

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Abstract: Background: traumatic brain injury is a real health problem, especially in low-income countries. The aim of this study was to assess the impact of helmet wearing on primary injuries in motorcycle trauma. Methods: this was a cross-sectional study from 1st January to 31st December 2013. It covered all motorcycle users, admitted in emergency at Cotonou National Teaching Hospital, with a traumatic brain injury. Epidemiological variables and primary lesions were identified. Statistical analysis was performed with Chi^2 and Fischer's tests; a p-value ≤ 0.05 was considered statistically significant. Results: we collected 310 patients (57.9% of traumatic brain injury), 11 of whom wore a helmet. They were predominantly male (male to female ratio =7.6), with a mean age of 33.2 ± 10.9 years. Craftsmen (24.4%) were the most affected. The head trauma was often opened (172 cases / 299) in patients without helmet compared with 4 cases / 11 in patients with helmet (p = 0.001). Similarly, primary lesions were often more severe in patients without helmet, with a large number of primary lesions requiring surgery. Conclusion: helmet wearing significantly reduces the risk of serious primary injuries in motorcyclists in our context. Strict enforcement of mandatory helmet use should reduce the incidence of disabling injuries in our country.

Keywords: Motorcyclist, Helmet Wearing, Traumatic Brain Injury

1. Introduction

Traumatic Brain Injury (TBI) is a public health problem [1, 2]. Their annual worldwide incidence is estimated at 10 million of cases, with a projection that they will be the 3rd cause of morbidity in 2020 [2, 3]. They mainly affect adolescents and young adults and occur mostly in low-and-middle-income countries [1, 4]. In sub-Saharan Africa, the incidence is greater, with an incidence of 150 -170 per 100,000 compared with a global average of 106 per 100,000 [1]. These traumas are responsible for heavy socio-economic, functional and vital consequences [1, 2]. In the United States of America, an estimation of 5.3 million persons are living with a disability resulting from traumatic brain injury [2]. In addition, the overall economic cost of these injuries was about $ 406 billion in 2000 [5]. In Benin, the average direct cost of traumatic brain injury was 285.67 ± 310.15 Euros (56.97 - 2055.21 Euros) [6]. These traumas often involve unprotected motorcyclists [6], which could worsen the lesions encountered and increase their socio-economic costs. The aim of this study was to assess the impact of helmet wearing on primary injuries in traumatic brain injury among motorcyclists in Cotonou.

2. Patients and Methods

2.1. Study Design and Population

This was a cross-sectional study from 1st January to 31st December 2013. It covered all motorcyclists, at least 15 years old, with a traumatic brain injury whom were admitted to

Cotonou National Teaching hospital, the level-1 referral hospital of Benin, a low-income country of West Africa. The health system of this country is third-level pyramid: the peripheral level (District or Communal health centers, supported by a regional referral hospital), the departmental level (departmental hospitals) and the national level (Cotonou National Teaching Hospital, and Mother and Child Teaching Hospital). In Benin, the rate of poverty was of 36.2%. There is limited rate of social coverage and insurances take a longtime before giving a care provision. The victim's family outside the hospitalization fees must prepay all care services. The cost of a daily hospitalization is 9.90 Euros for a common ward. CT scan was asked according to Masters classification [7]. But patients had to carry out at least one x-ray of the skull considering the lack social security, the low socio-economic status of the population, and the cost of brain tomodensitometry which was about 122 Euros, that is twice of the guaranteed minimum wage in Benin. They also had to consent to participate to the study when there are able to speak and write. For teenagers, and uncounscious patients, their parents also gave their consent.

2.2. Variables

Dependent variable was helmet wearing. Independent variables were epidemiological and clinical. Epidemiologically, age, sex, occupation, level of education, circumstances of the trauma were identified. On the clinical side, we noted the severity of the traumatic brain injury at admission, if the trauma was opened or not, and primary lesions of the traumatic brain injury found clinically or with radiologic explorations. When the Glasgow coma scale was greater or equal to 13, the traumatic brain injury was mild; Between 9 and 12, it was moderate and when it was less or equal to 8, it was a severe traumatic brain injury [8, 9].

2.3. Ethical Statement

This survey was conducted in compliance with the protocol Good Clinical Practices and Declaration of Helsinki principles. Written informed consent to participate in the study after being informed about the purpose of study was given by all included patients. We also received parental permission and the written consent of the parents about teenagers, and uncounscious patients. Investigators guaranteed the total anonymity of the information derived from the research.

2.4. Statistical Analysis

Statistical analysis was performed with EPI Info 7.2. Qualitative variables are expressed as frequencies. Quantitative variables are expressed as means ± standard deviation. The Chi^2 test of Pearson or the exact Fischer's test as appropriate) were used to search correlation between the dependent variable and independent variables. A p-value ≤ 0.05 was considered statistically significant. The confidence interval was set at 95%.

3. Results

3.1. Epidemiological Characteristics

We recruited 310 patients representing 57.9% of people with a traumatic brain injury received during this period. The mean age of the patients was 33.2 ± 10.9 years (15 - 64 years) and the 25-35 age group was the most affected with 120 cases (38.7%). There were 274 men (88.4%) and 36 women (11.6%), a male to female ratio of 7.6. Regarding level of education, 95 patients (30.6%) were non-educated; 85 patients (27.4%), 72 patients (23.2%) were respectively primary and secondary level school; finally, 58 patients (18.8%) had a university level. As far the profession is concerned craftsmen (24.2%) and taxi-motorcycle drivers commonly called "Zemidjan" in our country (22.6%) were the most concerned.

Traumatic circumstances were dominated by motorcycle against motorcycle collisions: 220 cases (71.0%), followed by motorcycle falls (74 cases or 23.9%) and motorcycle against car collisions (16 cases, 5.1%). The victims were drivers of the motorcycle in 279 cases (90.0%) and passengers in 31 cases (10.0%).

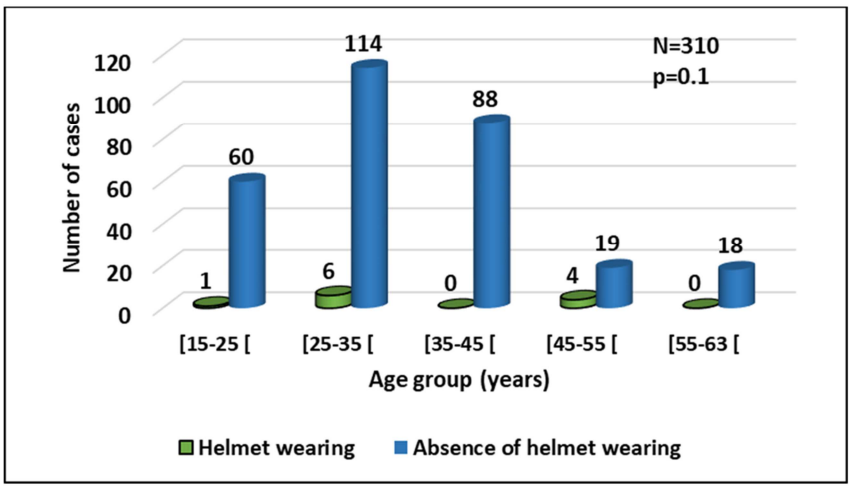

Figure 1. *Distribution of patients by age group and wearing or not of a helmet.*

Eleven of the 310 patients wore a helmet, which means 3.5% of patients. Helmets were worn by subjects aged 25-35 and especially 45-55 years (figure 1), with no statistical association between age and helmet wearing (p = 0.1; Chi^2 = 7.7). The rate of helmet wearing was 3.3% (9 cases / 274) for men and 5.6% (2 cases / 36) for women without a statistical link between sex and helmet wearing (p = 0.7, Chi^2 = 0.6). Civil servant had the best observance of helmet wearing as shown in figure 2; however, there is no association between occupation and helmet use (p = 0.08, Chi^2 = 9.8). According to the position of the victims on the motorcycle, the drivers wore a helmet in 3.9% and none passenger was wearing a helmet.

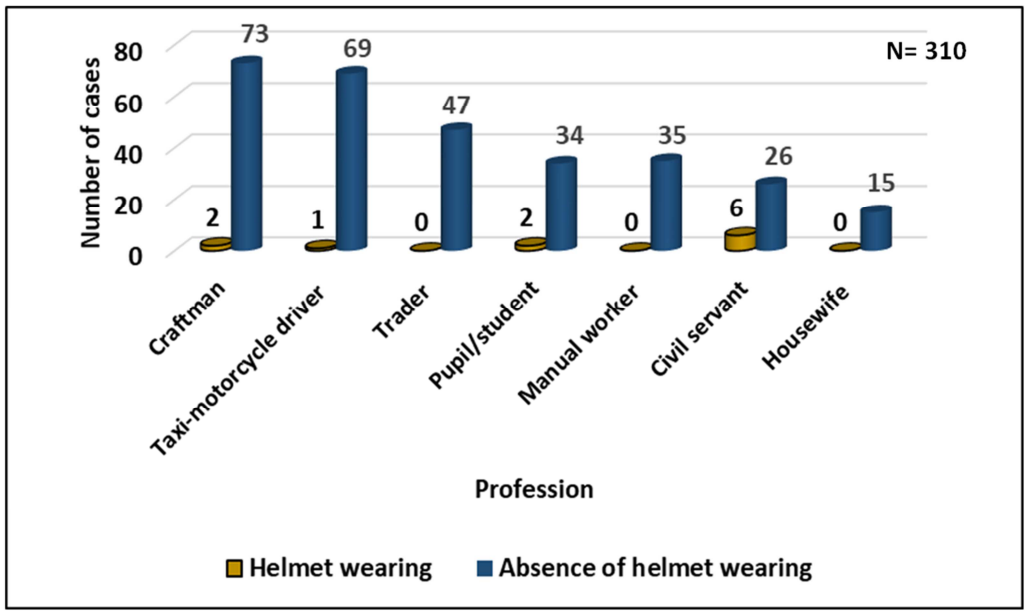

Figure 2. *Distribution of patients by occupation and wearing or not of a helmet.*

3.2. Clinical Characteristics

Most of traumatic brain injuries were mild (170 cases, or 54.8%). Moderate and severe traumatic brain injuries were found in 22.9% and 22.3% of cases, respectively. Most severe traumatic brain injuries were found in patients who didn't use helmet (figure 3), without statistical relationship between these two variables (p = 0.4, chi^2 = 3.9)

The traumatic brain injury was opened in 174 cases (56.1%) and closed in 136 cases (43.9%). Among those with opened trauma, 4 patients (0.6%) have used a helmet (figure 4). There was a statistical relationship between helmet wearing and the traumatic brain injury opening (p = 0.001; chi^2 = 8.4).

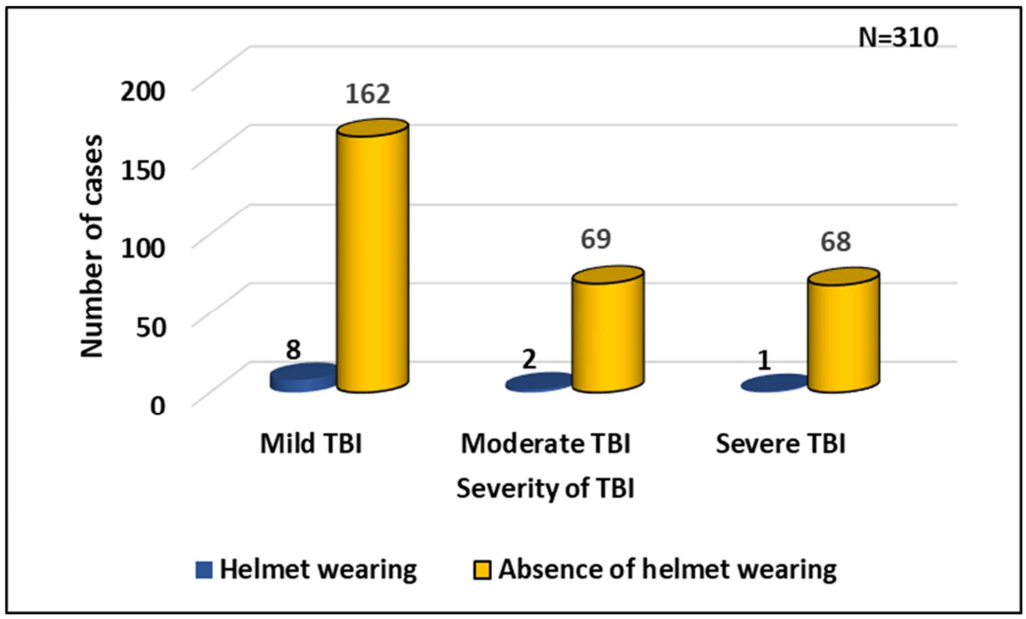

Figure 3. *Distribution of patients according to the severity of the trauma brain injury and the wearing or not of helmet.*

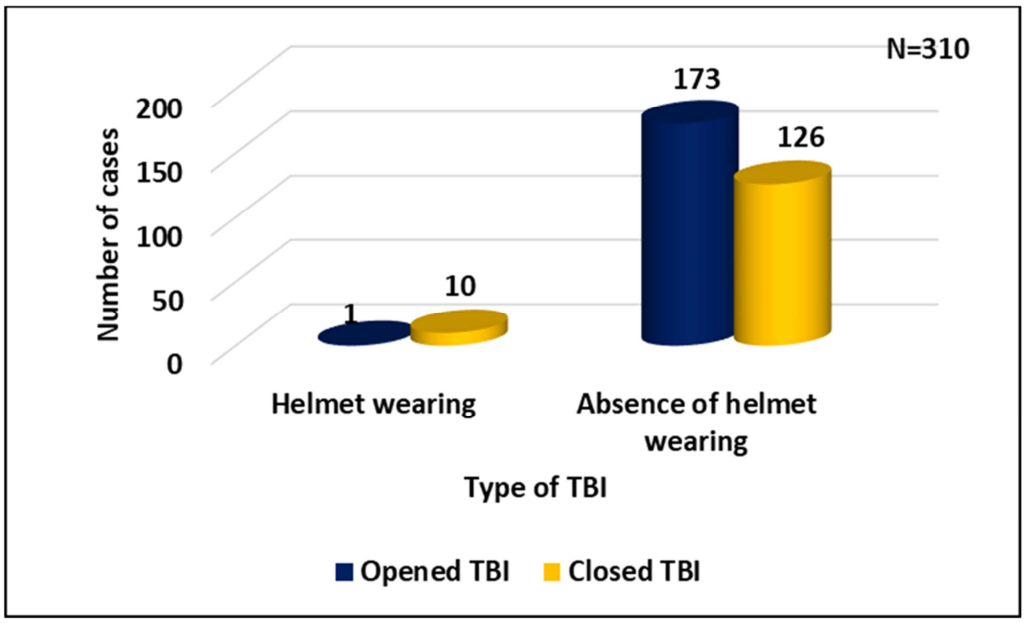

Figure 4. *Distribution of patients according to the opening of the trauma and the wearing or not of helmet.*

Primary lesions were dominated by scalp wounds (174 cases). Primary lesions requiring surgical treatment (scalp wounds, cranio-cerebral wounds, acute extradural and subdural hematomas, cranial bone fractures were more common in those without helmet (table 1). The extradural and subdural hematomas were found in 16 and 12 cases, respectively.

Table 1. *Distribution of primary lesions by wearing or not wearing of a helmet.*

	Helmet wearing	Absence of helmet wearing	Total	P-value	OR [IC 95%]
Scalp wounds	1	173	174	0.001	1.1 [1.0-1.5]
Cranio-cerebral wound	5	31	36	0.0003	7.2 [2.0-25.0]
Fracture of cranial vault	6	22	28	8.10^{-8}	15.1 [4.3-53.5]
Fracture of cranial base	3	19	22	0.03	5.5 [1.3-22.5]
Extradural hematoma	2	14	16	0.001	13.7 [3.5-53.1]
Acute subdural hematoma	3	9	12	0.006	12.1 [2.7-53.3]
Fracture of the facial bones	1	9	10	0.3	3.2 [0.4-27.9]
Intraparenchymal hematoma	1	7	8	0.2	4.2 [0.5-37.2]
Diffuse brain swelling	2	4	6	0.02	16.4 [2.6-101.4]
Subarachnoid haemorrhage	2	2	4	0.007	33 [4.2-261.3]
Diffuse axonal injury	1	1	2	0.07	27.1 [1.6-462.0]

4. Discussion

The aim of this study was to assess the impact of helmet wearing on primary injuries in traumatic brain injuries among motorcyclists at Cotonou. It presents a selection bias in the sense that some of the mild traumatic brain injuries are not included because they are not admitted in Cotonou National Teaching hospital. Similarly, the quality of the helmets used by the motorcyclists, who don't systematically buckle the straps of the helmet once worn, can't be stated with certainty. Finally, the speed of the motorcyclist during the accident should be taken into account for a better analysis of the results. However, this study, the first of its kind at the National Reference Center of Benin, is a starting point for more in-depth studies.

4.1. Epidemiological Characteristics

Several authors in the literature [10-14] have reported the young age and the male predominance found in this study. Traumatic brain injuries remain a major problem affecting the young subjects and thus handicaps the social and especially economic development of low-income countries such as ours. The compliance rate of helmet wearing was only 1.7% of the subjects aged of 15-25 years. One might think that the risk-taking largely responsible for these traumas is related to the young age of the subjects, but the situation is not too different in the elderly. Indeed, if in subjects of 45-55 years the observance of the helmet wearing holds 21%, there is nobody for the 55-63 years who wore a helmet. Furthermore, there was no statistical relationship between helmet use and patient age ($p = 0.1$). In fact, the reasons evocated to the non-wearing of helmet are often

personal: the discomfort occasioned by the helmet, the difficulties of auditing the horn of other road users, mobility of the neck especially to see back, and in the women, the difficulties of wearing helmets on braids. These frequent subjective reasons show the lack of awareness of the usefulness of wearing helmet by the motorcyclists at Cotonou. This confirms the present study with only a 3.5% helmet wearing compliance.

4.2. Clinical Characteristics

Traumatic brain injuries were opened in 174 cases (56.1%); Among these, only 1 patients (0.6%) were wearing helmet and there was a statistical link between the wearing of helmet and the occurrence of these lesions ($p = 0.01$). Wearing helmet would therefore protect against skin lesions of the scalp during traumatic brain injuries.

Similarly, the primary lesions requiring surgical management concerned patients without a helmet with a strong statistical link between the occurrence of these lesions and the wearing of helmet (table 1). It confirms the fact that wearing a helmet would reduce the severity of primary injuries, and thus the morbidity and mortality associated with traumatic brain injuries, although the quality of the helmet depends on the type of helmet and the way it is worn [15].

5. Conclusion

Helmet wearing significantly reduces the risk of severe primary injuries in motorcyclists at Cotonou. Unfortunately, it is not systematic in the latter despite its compulsory character in our country. Implementation by the government of sanctions for non-compliance with mandatory helmet wearing should reduce the incidence of disabling traumatic brain injuries in our country.

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