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Visual Abilities of Motorcyclists Injured in Road Traffic in the City of Kinshasa, the Democratic Republic of Congo (DRC)

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Abstract

Background and objective: In low- and middle-income countries, two-wheel drive (DRM) vehicles are operated for commercial purposes; it is a production tool. However, it is very vulnerable for passengers, the driver and even pedestrians. It exposes 38 times more to the risk of accidents than cars. Our objective was to determine the visual abilities of motorcyclists involved in ATR in the city of Kinshasa. *Methods*: A cross-sectional study with analytical purposes was carried out at the department of Ophthalmology of the university clinics of Kinshasa during a period from March to May 2023. 75 bikers were examined. The ophthalmological assessment included measurement of visual acuity, examination of the anterior segment using a biomicroscope, examination of the fundus using direct ophthalmoscopy, automatic refraction, monocular and binocular visual field using the confrontation method. and color vision. *Results*: All riders were male, with an average age of 37.3 ± 11.1 years with a range of 20 to 63 years. Two thirds of the bikers were married. The most common complaints were the sensation of grains of sand (98.6%), and the sensation of a foreign body (50.7%). The most noted anterior segment pathologies were pterygium (33.8%) and pinguecula (21.1%). The bikers were emmetropic in 58% of cases, presbyopic in 21%, myopic in 10%, hyperopic in 11% and astigmatic in 1% of cases. Intraocular pressure was elevated in 1.4% of motorcyclists. Color vision assessment showed dyschromatopsia in 2.4% of cases. Monocular and binocular visual fields were normal in more than 9 out of ten motorcyclists. At the fundus level, 1.4% of bikers showed signs of glaucoma and 5.3% showed signs of early hypertension. *Conclusion*: Almost all of the motorcyclists had visual acuity and visual field consistent with motorcycle driving at least in one eye. There was not a positive correlation between the visual skills of motorcyclists and the occurrence of accidents in this population group.

Subject Areas

Ophthalmology, Public Health

Keywords

Kinshasa, Motorcyclists, Accidents, Visual Acuity, Visual Functions

1. Introduction

In low- and middle-income countries, two-wheel drive (DRM) is used for commercial purposes. It is a production tool, a source of income for entire families, but in high-income countries, motorcycles are used more for leisure [1]. Young adults from rural areas are moving towards the capital in search of employment. However, after several months of unemployment in the city, they ended up getting into motorcycle taxi transport given the immediate remuneration, easy learning, low fuel consumption, ease of parking and maintenance [1].

However, riding a motorcycle is not without risks. It is very vulnerable for passengers, the driver and pedestrians. It is less safe than driving 4-wheel vehicles and exposes you to the risk of accidents 38 times more than the latter [1] [2] [3]. Indeed, driving a motorcycle is not an easy thing, it requires the integrity of all motor, sensory and cognitive functions, which are often used beyond their physiological limits, in more difficult weather conditions, particularly at night, during rainy weather, in the presence of fog, or in a dusty atmosphere [1]. The number of road traffic accidents (ATR) involving two-wheel drive is increasing [4] and thus constitutes the leading cause of death among children and young people aged 5 to 29 years. Men, especially those under 25, are 3 times more likely than women to experience ATR [5]. The global cost is estimated at around $518 billion per year for low- and middle-income countries at $65 billion; that is to say beyond the development aid they receive [1]-[9].

The DRC occupies 3rd position after Zimbabwe and the CAR with 34.4 deaths/100,000 inhabitants by road traffic accident [10]. Motorcycle transport in Kinshasa began around the 2010s and reached its scale in the 2013s. The scale of this activity coincided with the bankruptcy of mining companies in the provinces, resulting in the rural exodus towards the capital. where the already difficult job market will lead them to delve into this activity, already known to them but this time for commercial purposes.

In the context of this study, we are interested in the visual functions of motorcyclists. These bring together a set of natural sensory capacities of the eye. They allow us to perceive the outside world and interact with it. The motorcyclist is even more concerned because he goes where his eyes direct him, ninety percent of a motorcycle driver's activities depend on his visual abilities while only 10% depends on his mechanical knowledge [11].

The visual functions are varied, we cite: visual acuity, visual field, color vision, twilight vision, night vision, stereoscopic vision, contrast vision. It is the result of

the proper functioning of its visual functions which results in vision. Two of them are essential for motorcycle driving: visual acuity and visual field [12] [13].

Through visual acuity, the biker differentiates shapes, size, color, he sees objects in detail, but the visual field allows him to understand his environment in a global way without staring at it. Through its two essential functions, the biker sees precisely where he is going while managing his personal environment but also the environment 10 m - 50 m in front of him [12] [13].

Being in motion, the motorcyclist must keep his gaze mobile and constantly readjust his visual acuity and visual field to the new environment in which he finds himself. His visual acuity then becomes selective because the brain cannot process the multitude of information that the motorcyclist perceives, so it obscures some of it. Depending on the speed, the motorcyclist may not see a child who wants to cross, likewise his visual field is reduced as the speed is increased [14].

The environment also plays a role in the state of visual skills. Fine particles, dust, ultraviolet rays [15] added to this the different drugs influence visual abilities and make them less efficient through the occurrence of ocular disorders and pathologies such as: tearing, pruritus, grainy sensations sand, foreign bodies, photophobia, dry eyes, superficial punctate keratitis, corneal erosions and ulcers, cataract, pterygium, pinguecula, eventually glaucoma and age-related malignant degeneration. Our objective was to determine the visual abilities of motorcyclists involved in ATR in the city of Kinshasa by evaluating the visual functions of motorcyclists who experienced a road traffic accident in the main arteries of the city as well as by determining the ocular pathologies of this study population.

2. Materials and Methods

2.1. Nature and Period of the Study

The study carried out was transversal with an analytical aim. It took place over a period from March to May 2023, in the Ophthalmology department of the University Clinics of Kinshasa.

2.2. Population and Sampling

The population of this study consisted of injured motorcyclists from the provincial city of Kinshasa. Sampling was non-probability convenience type. Thus 75 injured motorcyclists constituted the sample size.

Selection criteria: Included in this study: any motorcyclist who has experienced an accident and who has agreed to take all the ophthalmological examinations required as part of this study by signing free and informed consent.

2.3. Variables of Interest

Sociodemographic data: age, sex, marital status, profession, level of education, number of hours of work per day, number of hours of rest per day, experience in driving, possession of a driving license.

Anamnestic elements: ocular history, consumption of alcohol or other drugs,

recorded ocular complaints.

Ophthalmological examinations: raw visual acuity near and far, biomicroscopy, tonometry, fundus, visual field, color vision.

Characteristics of the accident: Having already experienced an accident as a motorcyclist, the cause of the accident, the circumstance of the accident, the atmospheric conditions of the day.

Raw visual acuity at a distance: Considered normal, when it is between 1.0 and 0.6; subnormal between 0.5 and 0.3.

2.4. Operational Definitions and Data Collection Technique

To carry out this study, we used:

Data collection sheets, the glass box to try, the projection optotype, Parinaud's text, the slit lamp (Zeiss), the HEINE 200 ophthalmoscope, diagnostic eye drops: Fluorescein, a mydriaticum (Mydriaticum and/or Phenylephrine) an anesthetic. Goldman applanation tonometer, a pseudo-isochromatic atlas of Ishihara and American human optical, the 15-hue color vision pellet box and the 100-hue box.

Course of the study it was carried out:

• An ophthalmological examination which included: inspection, anterior segment biomicroscopy, intrinsic and extrinsic oculomotor skills, ocular tonometry, direct ophthalmoscopy.

• Functional tests and examinations which included: distance and near visual acuity, refraction, monocular and binocular visual field and color vision.

Criteria for evaluating visual functions:

• AV from afar: It was assessed with an Anglo-Saxon scale placed 6 m away from the patient. We looked at the OD first and then the OG. The examination was strictly monocular, the unexamined eye was covered with an eye patch. Normal distance visual acuity was ≥0.5 or 6/12.

• Near VA: it was evaluated after possible correction of the far VA. We used a board containing different paragraphs and different characters from Parinaud's text placed at a distance of 33 to 40 cm from the patient.

The rider who can read down to the smallest print is considered Normal. Otherwise, positive spherical lenses will be offered:

• Refraction: we have carried out the subjective lens testing method which consists of offering the subject a series of corrective lenses to improve distance vision.

• The monocular and binocular visual field (CV) by comparison.

• The biker fixes his eyes straight ahead, and the examiner stands in front of him, 60 cm away.

• The rider closes his left eye with his left hand while the examiner closes his own right eye with his right hand, so they have the same visual field.

• Then the examiner moves his hand from the periphery to the center and this successively, in the four quadrants.

• The rider must claim that he sees the examiner's hand; this must confirm the

normality of the motorcyclist's visual field according to what he himself perceives.

• Color vision: it was carried out using four tests. Two tests using pseudo isochromatic atlases: ISHIHARA (38 plates), AOHRR (20 plates) and two other so-called pigmentary tests: the Farnsworth dichotomous test series-D15 and the Farnsworth-Munsel 100 Hue test.

Were considered:

As normal: the ISHIHARA test: without error or with at most two errors in plates 2 to 17 (minor error). The AOHRR test: error-free in the detection and diagnosis series. Farnsworth D15-series: in ideal order (strictly normal) or with some minor errors without established dyschromatopsia axis. Farnsworth-Munsel test 100 Hue: those who had superior (0 and <20), average (21 and 100) and low (101 to 200) color discrimination were considered normal.

As pathological: the ISHIHARA test: with 3 or more errors. The AOHRR test: when an error has been detected and confirmed in the same axis. Farnsworth series-D15: when we found two lines at least parallel to one of the axes of dyschromatopsia (tritan, deutan, protan axis). Farnsworth-Munsel 100 Hue test: when the discrimination reaches a score above 200.

2.5. Ethical Considerations

The ethical principles linked to respect for the person, beneficence and justice were taken into account. Before administering the questionnaire, an informed consent form was presented and read to each rider. The registration of the motorcyclists in our study was carried out confidentially and in such a way as to protect their identities and preserve medical confidentiality. All hard-electronic archives were kept alone by the principal researcher in a well-secured location and access to the computer and telephone required a password to access them. Participants gave free and informed consent. The research protocol was presented to the staff and the local ethics committee. He received a favorable opinion.

2.6. Data Processing and Analysis

The data were entered and collected using the Kobo Collectv2022.2.3 software and exported to Excel while the analysis of these data was done with the Stata/SE17.0 software. Quantitative data were represented in the form of mean and standard deviation while qualitative data were represented in the form of frequency and proportions.

3. Results

3.1. General Characteristics of the Study Population

The study included 75 bikers, all of whom were male (100%). The average age of the bikers was 37.3 ± 11.1 years with extremes of 20 and 63 years. The age group of 30 to 39 years was the most represented with 33.8% of cases. More than eight

out of ten motorcyclists (85.6%) had a low level of education and almost two thirds (63.4%) were married. Riders work an average of 12.65 ± 2.36 hours per day (range: 7 to 18 hours) and rest on average for 2.39 ± 1.74 hours (range: 0 to 9 hours). Eight out of ten motorcyclists (81.7%) start work between 6 and 8 hours with an average of 6.79 ± 1.57 hours (Limit: 2 to 13 hours) and more than half (52.1%) finish their work after 8 p.m. with an average end of work time of 20.07 ± 1.92 hours (limits: 3 to 11 p.m.). 9.6 ± 3.2 is the average time spent most at work (43.7%). This different information is provided in Table 1 bellow.

Table 1. Baseline.

Sociodemographic characteristics		n, (%)	Mean ± SD*
Age (years)		-	37.28 ± 11.14
Educational level	Primary/secondary	63 (85.9)	-
	Tertiary	12 (14.1)	-
	Bachelor	24 (32.4)	
Marital status	Married	48 (63.4)	-
	Divorce	3 (4.2)	-
Number of years of motorcycle riding			14.31 ± 6.23
Driving license		42 (57.8)	-
Informal driving license		15 (43.3)	-
Ophthalmological examination before obtaining a driving license		3/42	-
Responsibility in relation to the motorcycle	Owner	48 (64.8)	-
	Employee	13 (16.9)	-
	CONTRACT	13 (16.9)	-
	Loan	1 (1.4)	-
Motorcycle maintenance	Every week	46 (62)	-
	Every 2 weeks	25 (32.4)	-
	Each month	3 (4.2)	-
	Every three months	1 (1.4)	-
Number of people transported	Often 2 people	73 (97.3)	-
	Rarely 2 people	1 (11.4)	-
	Rarely more than 2 people	32 (45.1)	-
	Rarely just one person	38 (53.5)	-
Wearing a protective helmet	Never	16 (21.1)	-
	Rarely	29 (36.6)	-
	Often	10 (14.1)	-
	Always	20 (28.2)	-
Number of working hours per day			12.65 ± 2.36
Number of hours of rest per day			2.39 ± 1.74
Working hours/day (hours)			9.6 ± 3.2
Daily payment per motorcycle (CDF*)			30,000 ±20,000

*Standard deviation, Congolese Devise Franc.

Nearly six out of ten motorcyclists (59.2%) have less than ten years of experience riding a motorcycle. More than half do not have a driving license (57.8%) compared to 42.2% (among whom four out of ten had received their driving license unofficially and 90% had not had an ophthalmological examination before obtaining a driving license). This different information is provided in Table 1 bellow.

Several difficulties encountered and several causes of accidents could be listed. Speeding, wrong maneuvers and inattention are the most predominant causes of accidents in 56.0%, 25.3% and 17.3% of cases respectively. And more than half of the accidents occurred between 6 and 12 hours (48%). Around one in six motorcyclists have experienced more than two motorcycle accidents. Nine out of ten motorcyclists reported encountering road harassment as their main difficulties (92%). More than eight out of ten motorcyclists learned to ride a motorcycle from a friend or family member. In 65 cases out of 75% or 87% compared to 10 cases out of 75 at the driving school 13%. This different information is provided in Table 1 bellow.

3.2. Characteristics of the Last Accident

Several difficulties encountered and several causes of accidents could be listed. Speeding, wrong maneuvers and inattention are the most predominant causes of accidents in 56.0%, 25.3% and 17.3% of cases respectively. And more than half of the accidents occurred between 6 and 12 hours (48%).

Around one in six motorcyclists have experienced more than two motorcycle accidents. Nine out of ten motorcyclists reported encountering road harassment as their main difficulties (92%). This different information is provided in Table 2 bellow.

3.3. Clinical Characteristics of Motorcyclists

The sensation of grains of sand was the main visual complaint of motorcyclists followed by the sensation of foreign bodies, photophobia and ocular itching in 98.6%, 50.7%, 31% and 28.2% of cases respectively. The majority of motorcyclists declared that they had no ocular history (70.8%) and 25% of them had already experienced ocular trauma. More than half of the bikers (62%) drank alcohol occasionally (56.8%). More than one in four motorcyclists took strong liquors "aguene". Almost all of the bikers did not use tobacco (Table 3).

3.4. Ophthalmological Examinations

This Table 4 bellow shows us that without correction, the distance visual acuity of the bikers was normal in 96% in the right eye and 94.6% in the left eye. 2 motorcyclists (2.7%) suffered from poor vision in the left eye and total blindness occurred in the right eye. More than nine out of ten motorcyclists had normal intraocular pressure. Hypertonia was found in 2 eyes. A motorcyclist presented with nasal discharge; almost all of the bikers had normal fundus. Pterygium and

dry eye followed by pinguecula are the most common pathologies at a rate of 26.97%; 20.22% and 16.85%. More than nine out of ten motorcyclists had normal color vision. Dyschromatopsia was represented in a proportion of 2.6%: deuteranopia in 1.3% in a color-blind person and a deficit of the red-green and blue-yellow axis in a proportion of 1.4% in a patient with cataract. Lower than, Table 4 provides us with information on these various details.

Table 2. Characteristics of the last accident.

Characteristics of the last motorcycle accident		n	%
Incriminated causes of the accident	Alcohol	3	4.0
	Speeding	42	56.0
	Inattention	13	17.3
	Technical fault	3	4.0
	False maneuvers	19	25.3
	Bad parking	1	1.3
	Not determined	6	8.0
Time of occurrence of the accident	Between 1 a.m. and 5 a.m.	1	1.3
	Between 6 a.m. to 12 p.m.	36	48.0
	Between 1 p.m. and 6 p.m.	25	33.3
	Between 7 p.m. and midnight	13	17.3
Weather situation	Normal	59	78.7
	Rain	13	17.3
	Wind	3	4.0
Road visibility	Good	64	85.3
	Bad	11	14.7
Road condition	Asphalted	53	70.7
	Unpaved	22	29.3
Road type	Straight	41	54.7
	Slope	34	45.3
Encountered difficulties	Traffic jams	48	64.0
	Road harassment	69	92.0
	Pedestrian lane	3	4.0
	Others	6	8.0
The most used circuit	Major arteries	74	98.7
	Neighborhood	1	1.3
Number of accidents	≤2 accidents	63	84.0
	>2 accidents	12	16.0

3.5. Distribution of Patients According to Refraction

As shown in Table 5 bellow, most participants had emmetropia (58.7%) and presbysia (21.3%).

Table 3. Distribution of motorcyclists according to clinical characteristics.

Clinical features		n	%
History of alcohol		46	62.0
Alcohol intake	Occasionally	26	56.8
	Each day	6	11.4
	Every week	15	31.8
Type of alcohol	Beer	41	56.3
	Whiskey	24	32.4
	Strong liquor (Aguene)	21	28.2
	Palm wine	17	22.5
Taking tobacco		6	7.8
Eye symptoms	Foreign body	38	50.7
	Photophobia	23	30.6
	Eye pritis	21	28.2
	Eye pain	19	25.4
	Reduced near vision	16	21.3
	Reduced distance vision	12	16.0
	Tingling sensation	14	18.6
	Blurred vision	11	14.7
	Headache	2	2.7
	Hemeralopia	2	2.7
	Diplopia	2	2.7
	Visual field restriction	1	1.3
	Foreign body	38	50.7
	Photophobia	23	30.6
	Eye pritis	21	28.2
	Eye pain	19	25.4
	Eye trauma	19	25.4
	Wearing glasses	1	1.3
	Cataracts	2	2.7

Table 4. Ophthalmological examinations.

Ophthalmological examinations		Right eye n, (%)	Left eye n, (%)	P
Distance visual acuity	Normal (1.0 - 0.6)	72 (96)	71 (94.6)	>0.05
	Subnormal (0.5 - 0.3)	2 (2.7)	2 (2.7)	-
	Visual impairment (0.2 - CD3M)	0	2 (2.7)	-
Total blindness (NPL * non-light perception)		1 (1.3)	0	-
Near visual acuity	NPL	1 (1.3)	0	-
	P2 *	57 (76)	57 (76)	-
	P3	3 (4)	3 (4	-
	P4	6 (8)	7 (9.3)	-
	P5	4 (5.3)	5 (6.7)	-
	P6 Parinaud	4 (5.3)	3 (4)	-
Tonometry	Hypotonia (<8 mmHg)	1 (1.3)	0	-
	Normal (8 - 21 mmHg)	73 (97.4)	74 (98.7)	-
	Hypertonia (>21 mmHg)	1 (1.3)	1 (1.3)	-
	Accessibility	74 (98.7)	75 (100)	-
Fundus of eye	Peripapillary atrophy	1 (1.3)	2 (2.6)	-
	Nasal discharge	1 (1.3)	0	-
	Normal macula	75 (100)	75 (100)	-
	Arterial narrowing	4 (5.3)	1 (1.3)	-
	Visual fields Pathological	2 (2.7)	1 (1.3)	-
Biomicroscopy	Pinguecula	7	8	-
	Pterygium	9	15	-
	Superficial punctate keratitis	9	9	-
	Adherent leukoma	1	0	-
	Grains of sand and limestone concretions	9	9	-
	hyperemia	3	3	-
	athalamia	1	0	-
	Lens opacity	3	3	-
Color vision	ISHIHARA			-
	Normal	63	62	-
	Minor error	10	12	-
	Deteuranopia	1	1	-
AO-HRR*	Normal	72	73	-
	Congenital mean red-green axis deficiency	1	1	-
	Acquired red-green axis deficit	1	1	-
PANEL 15	Normal	64	63	-
	Minor error	9	11	-
	Deteuranopia	1	1	-
	100 HUE			-
	Normal			-
	Superior discrimination	45	42	-

*AO-HRR: American Optical Hardy-Rand-Rittler.

Table 5. Ophthalmological examinations.

Refraction	n = 75	%
Presbyopic	16	21.3
Emmetrope	44	58.7
Hyperopia	8	10.6
Myopic	7	9.3
Astigmatism	1	1.3
Pathological binocular vision	2	2.7

4. Discussion

4.1. General Characteristic

All bikers were male (100%). A study conducted by Korir [16], in Kenya in 2012 out of 186 motorcyclists [16] presented similarities with our results: 100% of the motorcyclists were male. The same for Boadi samuel in 2016 in Ghana on 520 bikers [17], Salimatou M. *et al.* in 2017 in Nigeria on 80 bikers studied [18]. This is explained by the fact that motorcycle driving requires endurance, a certain taste for risk and recklessness. What characterizes the temperament of the male sex. Other authors have identified female motorcyclists in their studies but the sex ratio was more represented by males. In this study the average age was 37 ± 14.11 years. This result is similar to studies by Achigbu EO *et al.* in Nigeria who conducted a study in 2013 on 615 motorcyclists [17]. The mean age was 38.1 ± 10.27 years. For Boadi S. the average age was 39.23 ± 10.96 years [17]. At Salimatou M. & col in Benin the average age was 39.1 ± 11.4 years [18]. Other authors presented slightly lower results: for Korir the average age was 31.3 years [16]. At Sangowawa Ao in 2011 in Nigeria, the average age was 33.6 ± 9.1 years [19]. The age group of 30 to 40 years remains the most represented. This is the age of taking responsibility. Men become the main sources of income for their families. They are in a constant search for well-being for their home despite the extreme heat and bad weather to which they are exposed. Their young age gives them the necessary endurance. Married people represented 63.4% in this study. At Salimatou, almost all of the bikers were married (97.3%) [18]. They are responsible fathers of families. This activity provides them with what they need to establish a home. Some bikers, who are better organized, buy 2 or 3 motorcycles and hire other bikers. They even become land owners. From where they remain in this activity for a long time and transmit their knowledge to their posterity. The majority of bikers had a low level of education (85.6%). In Bénié's study [20], bikers with a low level of 73.3% [20] and 74.3% for Salimatou *et al.* [18] Madougou *et al.* [21] in his study in Benin in 2016 had a proportion of bikers with a low level which reached 97.7%. Most of them left rural areas, marked by poverty, for big cities. They did not benefit from extensive classical training in the provinces from which they came. In urban cities, the job market proved to be a closed environment for them from where they embarked on this remunerative

activity which was not very demanding in terms of training and maintenance.

4.2. Ophthalmological Data

The majority of them had gross vision adapted to driving, *i.e.*, 96.0% for the better eye, which is significantly similar to other studies in the literature. The study by Salimatou Monteiro *et al.* differs from our results with normal visual acuity only at 66.25% [18]. In the present study visual impairments were estimated at 4%. In Nigeria Achigbu: 2.3%, In Kenya Korir: 2.7%, OA Taiwo: 3.1%, Salimatou Monteiro *et al.*: 25%. Prabhath P *et al.* in a meta-analysis of 26 studies: 1.2% to 26.4% [22]. Uncorrected and neglected ametropia is the cause of a high rate of visual impairment in Salimatou Monteiro's study in Benin. The total blindness found in this study was due to open trauma to the globulus since childhood. The low vision was due to mature cataracts in two eyes and more advanced myopia in one eye. The predominance of eyes with normal visual acuity could be explained by the fact that almost all of the injured motorcyclists in this study were young subjects (under 40 years old) which gives them resistance to environmental aggression and they do not yet have enough vision problems because most diseases that impair vision (presbyopia, glaucoma, AMD) occur after the age of 40. From this age, year after year, eyesight declines and the eyes become vulnerable to attacks of age-related diseases.

4.3. Eye Complaints and Pathologies

The sensation of grains of sand was the main complaint (98.6%) followed by sensations of foreign bodies (50.7%) then came photophobia (31%) and ocular itching (28.2%). The wind and what it contains such as dust, grains of sand, blades of grass, pollen, insects or insect particles and other foreign bodies cause itching and photophobia. Eye complaints from motorcyclists are in a lower proportion compared to our results at Korir [16]. This is justified by the fact that since 2020 Kenya has developed a road safety policy consisting of the distribution and control of the wearing of helmets adapted to the hot and humid climate. The benefits are felt through the reduction of eye irritation. Salimatou M. [18]: pterygium had a lower prevalence of 13.75%. All these complaints and pathologies find their main causes in the environment. Pterygium, Pinguécula reflect the chronic effects of ultraviolet rays from the sun, dust on the ocular surface. It is in tropical regions, especially those close to the equator, that ultraviolet rays are more intense. Dry eyes are associated with limestone concretions and grains of sand on the eyelashes and in the fornixes. These grains of sand obstruct the secretory ducts of the meibomian glands and disrupt the spreading of the tear film on the corneal surface. The break up time will be short and the eye dries up and itching occurs, surface lesions take hold. These are superficial punctate keratitis (kps), epithelial lesions on the cornea making the eye sensitive to light (photophobia), and painful; and vision becomes blurry; not having the culture to consult an ophthalmologist the kps progress, extend and deepen to

become erosive lesions and later corneal ulcers. In the anterior segment: Cataract represents the only pathology of the anterior segment encountered in our study at 2.6%. The rate of cataracts is low for most studies carried out on motorcyclists following the average age. The most common cataract is of senile cause and occurs around the age of 60. In our study, the bikers who presented this anterior segment pathology were in their sixties. In the posterior segment: 4 bikers or 5.2% had arterial narrowing. This had no impact on the riders' visual skills. Salimatou *et al.* [18] did not observe posterior segment pathology. This is due to the fact that we have more young people in our study who are generally exempt from posterior segment pathologies. One case of glaucoma (1.3%) was identified in the study we conducted and this had no impact on the visual field. In early glaucoma, visual field abnormalities are subtle and difficult to spot, even with a modern visual field analyzer. A meta-analysis, after a compilation of 15 studies on motorcyclists, found that color vision disorders varied between 0.5% and 17.1%. According to this study there was a positive relationship between color vision disorders and the occurrence of accidents. This is explained by the fact that red traffic lights require vehicles to stop but the motorcyclist affected does not perceive this and runs the risk of hitting someone or colliding with another vehicle.

4.4. Binocular Visual Field Deficit

2 out of 75 motorcyclists (2.6%) presented a pathological binocular visual field. A mature cataract and adherent leukoma were the cause. Korir: 2.7% of the bikers in the study had a deficient visual field, Achigbu the visual field deficit was 2.3% with no link to the occurrence of accidents. An analysis bringing together 10 studies presented similar proportions with visual field deficits between 2% and 37.3%. This study found a link between visual field deficits and the occurrence of accidents [22]. In the present study, we did not obtain a statistically significant relationship between binocular visual field deficiency and the occurrence of accidents. This is in the same direction as certain authors such as Korir *et al.* in Kenya, unlike Salimatou in Benin [18] and Prabhath *et al.* [22]. This disparity in results could be explained by the fact that the motorcyclists studied are different from the point of view of respecting the Highway Code, the consumption of drugs which disrupt visual abilities, and respect for wearing a helmet. Their working environment differs from the point of view of air pollution.

5. Limitations of Study

During the exam we encountered other difficulties such as the refusal of some to continue the exam: either for superstitious reasons or because they found the exam too long.

6. Conclusion

This study shows that the visual acuity and binocular visual field of motorcycl-

ists were normal in most cases. Although speeding has been reported as the main cause of accidents, eye pathology is still common among motorcyclists. Pterygium is the most common, followed by dyschromatopsia. From a functional point of view, we did not obtain a causal link between visual functions and the occurrence of accidents.

Additional Information

Disclosures

All authors have confirmed that this study did not involve animal sub-jects or tissue.

Contribution of Authors

All authors confirmed having participated.

Conflicts of Interest

The authors declare no conflicts of interest.

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