Face shield (or helmet) as protection against pterygium among motorcycle taxi drivers in DKI Jakarta

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Abstract. Pterygium is a triangular form of fibrovascular tissue growing from the conjunctiva to the cornea in the interpalpebral region. Motorcycle taxi drivers are at risk for pterygium development due to factors including ultraviolet exposure, chronic dust irritation, and wind. The aim of the present study was to determine the effect of a face shield (or helmet) and other factors related to pterygium in such drivers. The study was conducted in two stages, with the first stage being cross-sectional and the second a case–control study with age group matching. The participants consisted of 131 drivers, and data collection was done using a self-administered questionnaire, an observation-based checklist, and an eye examination. The results showed that the prevalence of pterygium was 19.1%. Factors affecting the incidence of pterygium in the drivers were level of education (\( p = 0.029, \text{OR} = 3.310 \)), history of antioxidant consumption (\( p = 0.018, \text{OR} = 5.087 \)), knowledge regarding face shield wearing (\( p < 0.001, \text{OR} = 10.286 \)), and face shield wearing behavior (\( p < 0.001, \text{OR} = 11.156 \)). The results indicate that occurrence of pterygium in motorcycle taxi drivers can be reduced because of proper wearing of a face shield (or helmet).

1. Introduction

Pterygium is a wing-shaped growth in the conjunctiva bulbi. Pterygium is known to occur across the world but often occurs in hot, dry climates. Its prevalence in equatorial regions is approximately 22% and is less than 2% in latitudes above 40°. The prevalence of pterygium in Indonesia has been reported to be 10% by Gazard et al. Fitria reported that the prevalence of pterygium in the Aceh Besar coastal area was 58.71%, and Radilah reported that the prevalence of pterygium in trailer drivers in Jakarta was 48.2% [1-4].

Few studies have investigated factors involved in pterygium occurrence including those that are protective. Lu et al. reported that the use of a hat was associated with a 0.3-fold higher risk of pterygium than not wearing a hat, and the use of sunglasses was associated with an OR of 0.3 (0.1–0.6). Wanzhen et al. reported that higher levels of education were associated with lower pterygium risk, with an OR of 0.82 [2,5,6].

Several factors such as increasing public demand for transport, inadequate employment among some members of the community, and the lack of public transport in terms of quantity and service are
underlying causes for the proliferation of motorcycle driving as a means of livelihood among Indonesians [7].

Motorcycle taxis have become one of the most effective types of transport services because they can be used at any time, the service area is sufficiently large, and the cost is relatively low. Such motorcycle taxis can also be found in several other countries such as Bangkok, Nigeria (Okada), Benin (Zemidjan), and Cameroon [8].

In addition to traffic accidents, other potential hazards that can indirectly cause accidents among motorcycle drivers include disorders of the eyes or vision. Reduced visual function in workers leads to disruption of daily activity and reduced productivity. It has been challenging to obtain epidemiological data related to work-related eye diseases. Existing data represent sporadic research results and include data that show the prevalence of pterygium being 48.2% in trailer truck drivers, that of myopia in women tailors being 12.6%, and that of conjunctivitis in shoe factory workers being 10.9% [9].

In Indonesia, no studies have reported data on pterygium among motorcycle drivers. It is known that potential physical hazards to motorcycle riders include exposure to ultraviolet light due to outdoor work and exposure to dust and wind, which are also risk factors for pterygium.

Motorcyclists are required to use helmets that meet regulatory standards when driving. The use of standard helmets is one of the effective efforts in road safety management. Reports from the World Report on Traffic Injury Prevention released jointly by the World Health Organization and the World Bank in 2004 showed that helmet use has saved thousands of lives. There are several types of helmets on the market, including open helmets, closed helmets, a variety of helmets equipped with an anti-ultraviolet visor or clear visor. On the basis of the above, the present study investigated pterygium occurrence and the preventive effect of a face shield (helmet) among motorcycle riders [10].

2. Methods

The study was conducted in two stages: the research design used in the first stage was cross-sectional and that in the second was matched case–control. Age was used as an equivalent in the case–control study. The participants included a case group of motorcycle riders who suffered from pterygium and a control group of motorcycle riders who did not suffer from pterygium.

The population of this study was motorcycle riders around the Duren-Kalibata Commuter Line station; the data were collected during April 2017. The Lemeshow formula was used to determine a sample of 106 respondents for the first phase. For the second phase, the OpenEpi software with data from a study by Khoo et al. (1999) was used to determine a case group of 25 respondents and a control group of 75 respondents. Respondents were included only if they were motorcycle taxi drivers older than 20 years, had worked as a motorcycle rider for at least 3 years, and were willing to participate in the study. Exclusion criteria were pinguecula, pseudopterygium, and benign or malignant tumors in the conjunctiva.

The dependent variable in the study was the presence or absence of pterygium. The diagnosis of pterygium was made by a general practitioner on the basis of the discovery of yellowish to triangular pink fibrovascular masses in the bulbar conjunctiva in the interpalpebral fissure region at 3 or 9 o’clock with the apex/head attached to the cornea. These findings were documented using cameras and diagnosis was confirmed by optometrists.

Independent variables consisted of the level of knowledge regarding the use of a face shield (or helmet) while driving, attitude regarding the use of a face shield (or helmet) while driving, and face shield (or helmet) wearing behavior when driving; these were assessed via questionnaires and observation for 3 days; the extent of daily work as an ojek driver, history of antioxidant consumption, smoking habits, age, education, and helmet type were also assessed.

The data were collected and entered into Microsoft Excel. The data were represented in the form of text and tables and were analyzed using the Statistical Package for the Social Sciences version 22 for Windows.
3. Results
The results of bivariate analysis showed a statistically significant correlation between pterygium occurrence and education, antioxidant consumption history, and knowledge and behavior regarding a face shield (or helmet), as shown in Table 1.

| Variable                              | Pterygium Cases | Control | p        | OR (95% CI)           |
|---------------------------------------|-----------------|---------|----------|-----------------------|
|                                       | n   | %    | n   | %    |                      |
| Age                                   |     |      |     |      |                       |
| > 40 years                            | 21  | 84   | 61  | 81   | 0.513 1.205 (0.357–4.068) |
| ≤ 40 years                            | 4   | 16   | 14  | 19   |                      |
| Education                             |     |      |     |      |                       |
| Low                                  | 21  | 84   | 46  | 61   | 0.029 3.310 (1.031–10.620) |
| High                                 | 4   | 16   | 29  | 39   |                      |
| Consumption of Antioxidants           |     |      |     |      |                       |
| Less                                  | 23  | 92   | 52  | 69   | 0.018 5.087 (1.106–23.397) |
| Well                                 | 2   | 8    | 23  | 31   |                      |
| Smoking Habit                         |     |      |     |      |                       |
| Smokers                               | 19  | 76   | 55  | 73   | 0.792 1.152 (0.403–3.294) |
| Heavy Smokers*                        | 3   | 13   |     |      |                      |
| Moderate Smokers*                     | 12  | 32   |     |      |                      |
| Light Smokers*                        | 4   | 10   |     |      |                      |
| Non Smokers                           | 6   | 24   | 20  | 27   |                      |
| Working Period                        |     |      |     |      |                       |
| ≥ 5 years                             | 23  | 92   | 56  | 75   | 0.053 3.902 (0.840–18.123) |
| < 5 years                             | 2   | 8    | 19  | 25   |                      |
| Length of Working                     |     |      |     |      |                       |
| ≥ 5 hours per day                     | 24  | 96   | 70  | 93   | 0.531 11.156 (0.191–15.418) |
| < 5 hours per day                     | 1   | 4    | 5   | 7    |                      |
| Helmet Type                           |     |      |     |      |                       |
| Open Helmet                           | 24  | 96   | 64  | 85   | 0.141 4.125 (0.505–33.692) |
| Close Helmet                          | 1   | 4    | 11  | 15   |                      |
| Knowledge regarding Face Shield (Helmet) |     |      |     |      |                       |
| Low                                   | 18  | 72   | 15  | 20   | <0.001 10.286 (3.634–29.111) |
| High                                  | 7   | 28   | 60  | 80   |                      |
| Attitude regarding Face Shield (Helmet) |     |      |     |      |                       |
| Negative                              | 13  | 52   | 48  | 64   | 0.287 0.609 (0.244–1.522) |
| Positive                              | 12  | 48   | 27  | 26   |                      |
| Face Shield (Helmet) wearing behavior |     |      |     |      |                       |
| Less                                  | 21  | 84   | 24  | 32   | <0.001 11.156 (3.448–36.096) |
| Well                                  | 4   | 16   | 51  | 68   |                      |

On the basis of the above findings, the statistically insignificant risk factors were age, smoking habit, length of service, helmet type, and attitude regarding face shield (or helmet). Multivariate analysis was then performed, and the results are shown in Table 2.
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Table 2. The most influential risk factors

| Variable                                | B    | SE  | OR   | 95% CI          | P    |
|-----------------------------------------|------|-----|------|------------------|------|
| Less face shield wearing behavior       | 1.883| 0.697| 6.574| 1.676–25.790     | 0.007*|
| Low Knowledge of face shield            | 1.625| 0.623| 5.078| 1.498–17.208     | 0.009*|
| Less Consumption of Antioxidants        | 1.349| 0.891| 3.852| 0.671–22.101     | 0.130 |
| Low Education                           | 1.351| 0.738| 2.709| 0.637–11.512     | 0.177 |
| Working Period                          | 0.997| 0.932| 5.525| 0.890–34.314     | 0.67  |
| Open Helmet Type                        | 1.709| 1.276| 4.182| 0.343–50.993     | 0.262 |

*p<0.05

The results of multivariate analysis revealed that the determining factor for pterygium occurrence in motorbike drivers in DKI Jakarta was a behavior of lesser face shield (or helmet) wearing.

4. Discussion

There were challenges in observing the behavior of face shield (or helmet) wearing among the respondents because the researcher or research assistant could conduct observations only around the base when the respondent departs or drives home. The observations could not be done while the respondent was working (driving). We attempted to overcome this limitation by conducting observations for 3 days, to more accurately represent the daily behavior of the respondents. To avoid bias, respondents were not made aware that observations regarding the face shield (or helmet) were being conducted.

An $r^2$ value of 0.498 indicated that the association of knowledge and behavioral variables regarding face shield (or helmet) with pterygium occurrence is 49.8% and that other factors affecting pterygium represent the remaining 50.2%. Some of the other factors that may be involved include the use of glasses, the habit of driving long distances (touring) outside working hours, and a history of eye drop use.

In the questionnaires in the present study, respondents stated good consumption of antioxidants in the form of consumption of food sources contained antioxidants (supplements, vegetables, and fruits) of not less than five servings a day. The World Health Organization generally recommends consumption of vegetables and fruits for a healthy life of 400 g per person per day, consisting of 250 g of vegetables (equivalent to 2½ servings or 2½ cup vegetables after cooking and draining) and 150 g of fruit (equivalent to 3 medium-size ambon bananas or 1½ piece medium-size papaya or 3 medium-size oranges). In Indonesia, the recommended consumption of vegetables and fruits is 400–600 g per person per day for adolescents and adults. Approximately two-thirds of the above recommended amount is vegetables. We categorized respondents into those consuming antioxidant sources of more than five servings a day and those who consumed antioxidant sources of less than five servings a day [11].

More in-depth questions regarding antioxidant consumption are required to obtain more accurate data, such as using 24 h food recall and food frequency questionnaires [12].

4.1. Prevalence of Pterygium

Pterygium prevalence was 19.1% among 131 respondents. The prevalence of pterygium in Indonesia reported by Gazard et al. in 2002 was 10%, with prevalence among those aged 40–49 years being
16.4% and that among those aged >50 years being 17.3%. Laszuarni (2002) reported that the prevalence of pterygium in Langkat regency of North Sumatera was 38.2% in the 31–40 year age group, and 26.1% in the 41–50 year age group. Achiqgbe et al. reported in 2014 that the prevalence of pterygium in motorcycle taxi drivers in Nigeria amounted to 19.3%. The prevalence figure obtained in the present study is similar to that reported by Achiqgbe et al., probably because of similar research locations (equatorial) and similar subjects (motorcycle drivers) [2,12,13].

4.2. The Effect of Sociodemographic Factors on Pterygium Incidence
There was no statistically significant association of age with pterygium incidence ($p \geq 0.05$), although the proportion of pterygium at age $>40$ years was 84%. This is consistent with a study by Khoo et al. (1999) who reported that age had no significant association with pterygium events. Wanzhen et al. (2014) reported that there was a significant association between age and pterygium events, with age groups of 60–69 and 70–79 years showing a 1,425- and 1,610-fold higher risk, respectively, than the age group of <60 years. This may have been because the majority of research subjects were over 40 years of age [6-14].

There was a statistically significant relationship of education with pterygium events, with low levels of education being associated with a 3.3-fold higher risk of pterygium than higher education levels. This result is in accordance with a study by Young-Pyo et al. (2016) which found that low education was associated with a 6.5-fold higher risk of pterygium [15].

Higher antioxidant consumption was associated with a 5,087-fold lesser risk of pterygium compared with lower antioxidant consumption ($p = 0.018$). There have been no studies investigating the association of antioxidant consumption with pterygium events, but this result is consistent with a study by Kormanovski et al. (2014), who reported that oxidative stress has an important role in the incidence and recurrence of pterygium [16].

There was no statistically significant relationship of smoking with pterygium incidence ($p > 0.05$). This is consistent with a study conducted by Gazard et al. (2002) who reported that there was no significant association between smoking habits and pterygium events. The association of smoking habits with pterygium events is controversial, with some studies such as that by Song et al. reporting that smoking habits significantly reduced the risk of developing pterygium with an OR of 0.65. In contrast, Fotoihi et al. (2008) reported that smoking increased the risk of pterygium events by 2.7-fold compared with non-smoking. A challenge in assessing the effect of smoking on pterygium occurrence may have been the fact that the respondents (motorcycle drivers) smoked while waiting for passengers, so that on average, almost all nearby motorcycle drivers, even non-smokers, were exposed to cigarette smoke [17,18].

4.3. The Effect of Socio-occupational Factors on Pterygium Incidence
There was no statistically significant relationship of working period with pterygium incidence ($p = 0.053$). This differs from the findings of a study conducted by Gazard et al. (2002) who showed that outdoor activities over a period of 10 years for more than 5 h per day were associated with a 2.04-fold higher risk of pterygium [2].

Variable length of work was also not associated with pterygium events. This finding is inconsistent with those in studies by Gazard et al. (2002) and Durkin Ddkk (2008) who reported a significant relationship between the duration of outdoor activity and pterygium events with $p = 0.001$. This contradiction may be due to a similar proportion of respondents working over 5 h per day in both the case and control groups, with the majority working more than 5 h per day [2-19].

The type of personal protective equipment (PPE) showed no significant correlation to pterygium occurrence ($p = 0.141$). This is not in accordance with a study conducted by Laszuarn, which found that the use of glasses as a means of personal protection had a significant relationship with the incidence of pterygium ($p = 0.007$). Similarly, Anbesse et al. (2017) reported that the use of glasses or hats is a protective factor against the incidence of pterygium with $p = 0.007$. This contradiction may have occurred because most respondents used open helmet types [10,20].
4.4. The Influence of Knowledge, Attitudes, and Behavior Regarding the Use of a Face Shield (or Helmet) on Pterygium Occurrence

Use of appropriate PPE such as glasses, wide caps, or helmets meeting regulatory standards was assessed via questionnaires and observation. The results of statistical analysis of the data showed a significant relationship between knowledge of PPE ($p < 0.001$) and pterygium occurrence. It is known that a low knowledge level is associated with a 10.3-fold higher risk of suffering from pterygium [21].

However, there was no statistically significant relationship between attitude regarding a face shield (or helmet) and pterygium incidence. This may have been because the proportions of the case group and the control group with negative attitudes were almost similar, at 52% and 64%, respectively.

The behavior of proper face shield (or helmet) wearing was found to be associated with a 11-fold lesser risk of pterygium occurrence compared with improper wearing. This is consistent with a study conducted by Lu and colleagues in 2009 who reported that rare use of spectacles and caps was associated with a 1.5-fold higher pterygium risk compared with frequent use of glasses and hats ($p < 0.001$ and $p = 0.01$, respectively) [22].

4.5. Determinant Factors of Pterygium Occurrence in Motorcycle Drivers

The results of multivariate analysis showed that there were some independent variables related to pterygium incidence, with the results showing that respondents with less use of a face shield (or helmet) had a 6,574-fold higher likelihood of suffering from pterygium compared with other respondents. Another independent variable that also had a statistically significant relationship with pterygium incidence was knowledge regarding use of a face shield (or helmet) with an OR of 5.078, indicating that low knowledge regarding the use of a face shield (or helmet) was associated with a 5,078-fold higher likelihood of pterygium incidence compared with high knowledge regarding the use of a face shield (or helmet).

This is consistent with the theory that individual behaviors in the use of PPE are basically the result of interactions among a group of stimuli. There are several stimulus groups known to influence the behavior of PPE usage, such as knowledge and attitude about PPE, availability of PPE, and human resource support capacity around individuals who supervise the use of PPE.

Few studies have investigated factors involved in pterygium occurrence including those that are protective. A study by Lutra (2001) found that the use of sunglasses or a hat slightly increases the risk of pterygium, by 0.104 (0.052–0.209) times. Lu et al. (2007) reported that the use of a hat was associated with a 0.3-fold higher risk of pterygium than not wearing a hat, and the use of sunglasses was associated with an OR of 0.3 (0.1–0.6) [23].

5. Conclusions

Motorcycle taxi drivers in DKI Jakarta with more knowledge regarding face shield (or helmet) usage and exhibited proper use of a face shield (or helmet) had a lower risk of pterygium than other drivers.

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