ARTICLE INFO

AUTHOR'S AFFILIATIONS
Faculty of Medicine, University of Pembangunan Nasional Veteran Jakarta[1]
Department of Orthopedic Surgery, Faculty of Medicine, University of Pembangunan Nasional Veteran Jakarta, Indonesia[2]
Department of Neurosurgery, Faculty of Medicine, University of Pembangunan Nasional Veteran Jakarta[3]
Department of Anatomy, Faculty of Medicine, University of Pembangunan Nasional Veteran Jakarta[4]

CORRESPONDING AUTHOR
Basuki Supartono
Department of Orthopedic Surgery, Faculty of Medicine, University of Pembangunan Nasional Veteran Jakarta, Indonesia
E-mail:
basuki@upnvj.ac.id

Article history

Received	27-12-2024
Revised	17-03-2025
Accepted	25-03-2025
Available online	31-03-2025

Please cite this article in APA 7th edition style as:
Nugrahana, R. Y., Supartono, B., Makkiyah, F. A., & Heristyorini, A. (2025). Knee Osteoarthritis Risk is Increased Five-Fold After Knee Injury in Indonesian National Police Mobile Brigade Corps. *Jurnal Ilmiah Kedokteran Wijaya Kusuma, 14 (1), 61-70*

http://dx.doi.org/10.30742/jikw.v14i1.4174

Knee Osteoarthritis Risk is Increased 5-Fold After Knee Injury in Indonesian National Police Mobile Brigade Corps

Raisa Yunika Nugrahana[1], Basuki Supartono[2], Feda Anisah Makkiyah[3], Ayodya Heristyorini[4]*

Abstract

Background: It is known that knee osteoarthritis (OA) is correlated with knee injury and plays an important role in the expansion of knee OA. **Objective**: This research aims to find out the relationship between knee injury history with knee OA severity and to estimate the risk of knee OA after knee injury. **Methods:** This research used observational analytical methods with a retrospective hospital-based cohort study design. Using consecutive sampling technique. The total research sample was 68 participants who Indonesian National Police Mobile Brigade Corps had knee OA period January 1, 2021-December 31, 2023 at the RS Bhayangkara Tk. I Pusdokkes Polri Jakarta. **Result:** There was a significant relation between knee injury history with knee OA severity (p = 0.011) and odds ratio 5.0 (95% CI: 1.6-15.9). Characteristics of members of the Indonesian National Police Mobile Brigade Corps with the highest risk of knee OA, namely in the pre-elderly with an age range of 45 - ≤ 59 years (66.2%), female (51.5%), work unit of the Headquarters Mobile Brigade Corps (45.6%), had a history of knee injury (70.6%), with mild degrees (1-3) (73.5%), and the majority experienced anterior cruciate ligament (ACL) injury (23.5%). **Conclusion:** A significant correlation was found between knee injury history and knee OA, with a 5-fold increased risk post-injury. The findings support the development of prevention, early detection, and rehabilitation programs to improve quality of life and operational performance. Future research should explore targeted interventions to reduce this risk and enhance long-term joint health.

Keywords: anterior cruriate ligament (ACL) injury, Indonesian National Police Mobile Brigade Corps, knee osteoarthritis, knee injury history

Original Research Article

INTRODUCTION

A musculoskeletal disease condition that worsens with time, namely knee osteoarthritis (OA) is strongly linked to mechanobiological variables. Damage can occur to all joint tissues including cartilage, subchondral, synovial fluid, and ligaments in the joint area (Supartono et al., 2020).

According to Supartono, et al., (2018), the state and public health are burdened by knee OA. Knee OA affects 151.4 million people worldwide and 27.4 million in Southeast Asia (Supartono et al., 2020).

Supartono, et al., (2020) explained that in Indonesia the incidence of knee OA reached 24.7%. East Nusa Tenggara Province is the province with the most knee OA sufferers, which is around 33.1%. Riau Province is the province with the lowest knee OA sufferers, which is around 9%. Meanwhile, DKI Jakarta occupies the fourth position with the highest number of knee OA sufferers, which is 21.8%.

In a study by Supartono, et al., (2018) the frequency of knee OA rises significantly in women with age up to the age of 45. After that, males are more likely than women to have knee OA. The female gender with an age range of 45-59 years, has the highest prevalence of OA. According to Kellgren-Lawrence, grade III knee OA is the most common type.

Poulsen, et al., (2019) stated that women with an age range of 28-38 years old who have a history of knee injuries, such as anterior cruriate ligament (ACL) injury, meniscus tear or a combination of both have a 4-6 times risk of knee OA. This is in line with the findings of Dhaifullah, et al., (2023) and Wulandari, et al., (2023), which show that women between the ages of 60 and 75 who are often housewives account for 69.2% of the the severity of knee OA.

This opinion, however, runs counter to Rahmanto & Aisyah, (2019) research, which found that males between the ages of 30 and 59 had a greater chance of developing knee OA if they have a history of knee injuries.

The Indonesian National Police Mobile Brigade Corps is categorized as a occupation with high physical activity so the risk of knee injury is very high. In their daily lives, Indonesian National Police Mobile Brigade Corps carry out activities such as daily routine physical exercise, running, climbing rocks or heights, standing for long periods (2 hours/day or every day), walking long distances (2 hours/day or every day), lifting heavy objects (10 kg-50 kg/day for 10 or more times a week), pushing heavy objects (10 kg-50 kg/day for 10 or more times a week), going up and down stairs every day and others (Lentz et al., 2020).

According to the findings of a study by Orr, et al., (2023), police officers are at a greater risk of suffering a musculoskeletal injury (MSI) since this scenario might happen frequently.

Thus, this study aimed to evaluated the risk of acquiring clinically diagnosed knee OA among individuals who did not receive a diagnosis after suffering different kinds of knee injuries. This study is important because it may help the Indonesian National Police Mobile Brigade Corps prevent knee OA and enhance everyday functioning.

As the study to employ a retrospective hospital-based cohort study activity-duty Indonesian National Police Mobile Brigade Corps patients, we discovered that knee OA at pre-elderly age rose approximately five times following knee injury as compared to no injury. Anterior cruriate ligament (ACL) injuries had the highest estimations of increased risk among all injury categories.

The close link knee injuries especially anterior cruriate ligament (ACL) injury and increased osteoarthritis (OA) risk is well established, with previous reports estimating a 5-fold increased risk (Poulsen, et al., 2019; Snoeker et al., 2020). However, few studies concentrate on high-activity cohorts such as police officers, who are exposed to specific occupational hazards. This Study attempts to fill this gap by investigating OA risk in members of the Indonesian National Police Mobile Brigade Corps. Furthermore, in this context, the novelty is to quantify the 5-fold increased risk of OA after knee injury in this specific demographic and the need to focus prevention strategies accordingly.

METHODS

Design

This study is a retrospective hospital-based cohort study from October-November of 2024.

Participants and centres

We evaluated the minimum sample size in this study was 68 samples from the form of registered patient medical record documents the Indonesian National Police Mobile Brigade Corps diagnosis with knee OA in the period January 1 2021-December 31 2023, located at the RS Bhayangkara Tk. I Pusdokkes Polri Jakarta. Research Ethics Committee approval for the project was granted by the RS Bhayangkara Tk. I Pusdokkes Polri Jakarta (KET/EC-231/X/2024/RS.BHAY.TK.I) **(figure 1).**

Eligibility criteria

We included studies meeting the following criteria inclusion: 1) Patients of the Indonesian National Police Mobile Brigade Corps at the RS Bhayangkara Tk. I Pusdokkes Polri Jakarta in 2021-2023 who were diagnosed with knee OA, unilateral or bilateral, and were male or female with an age range of ≥ 19 - 44 years to 45 - ≤ 59 years who were still actively working; 2) Have a history of knee injury within 6-12 months or 10-20 years or have a recurring injury before being diagnosed with knee OA; 3) The patient has radiologic support examination results with anteroposterior (AP)/Lateral projection of the knee.

The exclusion criteria for this study were: 1) Patients with incomplete and inappropriate medical record data such as no information on age, gender, work unit of the Mobile Brigade Corps of the Indonesian National Police, results of radiological support examinations with anteroposterior (AP)/Lateral projections on the knee, history of knee injury, and diagnosis of knee OA severity; 2) Knee OA patients who are obese according to WHO criteria and have postural disorders such as scoliosis, flat feet, or hyperlaxity; 3) OA patients other than knee OA; 4) Knee OA patients who have metabolic disorders such as diabetes mellitus or gout arthritis.

Data analysis

We determined the likelihood of knee OA following a knee injury (p value < 0.05) and examined the association between knee injury and knee OA using the Chi-square test. 95% was the significance threshold.

RESULTS

The sample's basic description indicates that the biggest of patients of the Indonesian National Police Mobile Brigade Corps suffering from mild knee OA (Grade 1-3) as many as 50 people (73.5%) with knee injury history (70.6%) at the RS Bhayangkara Tk. I Pusdokkes Polri Jakarta are in the age range of 45 - ≤59 (pre-elderly) as many as 45 people (66.2%), female as many as 35 people (51.5%) with the work unit of the Mobile Brigade Corps Headquarters as many as 37 people (54.4%) **(table 1)**.

The percentage of patients of the Indonesian National Police Mobile Brigade Corps who were knee injury was patella fracture (8.8%), hamstring injury (7.4%), meniscus tear (13.2%), femur fracture (2.9%), anterior cruriate ligament (ACL) injury (23.5%), patella dislocation (4.4%), and tendon patella rupture (10.3%) **(table 2)**.

On the variable knee injury history as an independent variable and the knee OA as a dependent variable, a Chi-Square test was carried out in the form of a 2x2 table. Based on the test results, the Sig value (p value) = 0.011 < 0.05. These results show that there is a statistically significant association between knee injury history and knee OA. Patients in the Indonesian National Police Mobile Brigade Corps population having a history of knee injuries had OR (95% CI: 1.568-15.942) values that were around 5-fold higher than those without a history of knee injuries **(table 3).**

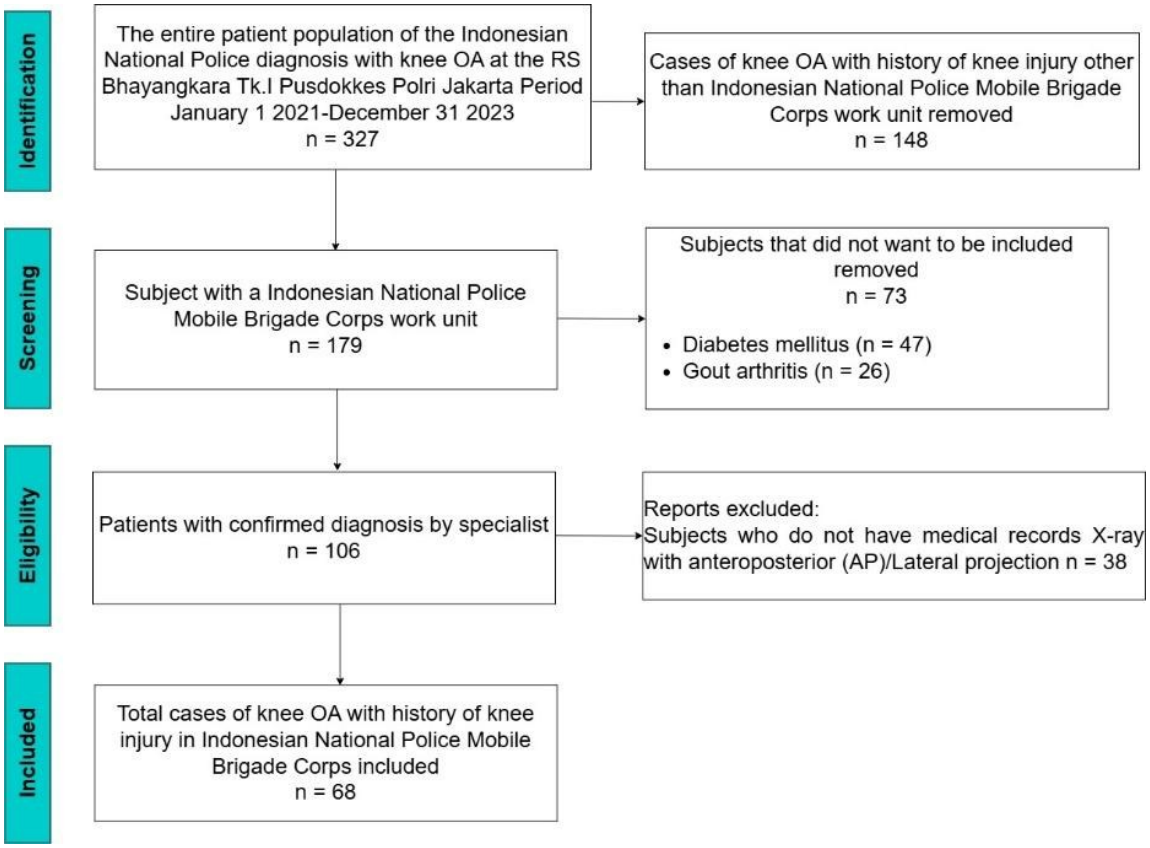

Figure 1. Flowchart of Study Inclusion and Exclusion Knee OA Cases

Table 1. Baseline Characteristics

Characteristics	With Knee Injury n=48 (70.6%)	Without knee Injury n=20 (29.4%)	Percentage (%)
Age, years			
Adult (≥19 – 44)	21	2	33.8
Pre-elderly (45 - ≤59)	27	18	66.2
Sex			
Male	24	9	48.5
Female	24	11	51.5
Work Unit Indonesian National Police Mobile Brigade Corps			
Mobile Brigade Corps Headquarter	28	9	54.4
Mobile Brigade Corps Regional Police	20	11	45.6
Knee OA Severity			
Mild (Grade 1-3)	40	10	73.5
Severe (Grade 4)	8	10	26.5

Secondary data, 2021-2023

Table 2. Types of Knee Injury

Types of Knee Injury	Male n=24	Female n=24	Percentage (%)
Patella Fracture	4	2	8.8
Hamstring Injury	3	2	7.4
Meniscus Tear	1	8	13.2
Femur Fracture	2	0	2.9
Anterior Cruriate Ligament (ACL) Injury	11	5	23.5
Patella Dislocation	2	1	4.4
Tendon Patella Rupture	1	6	10.3

Secondary data, 2021-2023

Table 3. The Correlation Between Knee Injury History with Knee OA

Variables	Knee OA Severity				Total		*p-value*	OR	95% CI	
	Mild (Grade 1-3)		Severe (Grade 4)						Lower	Upper
Knee Injury History	**n**	**%**	**n**	**%**	**n**	**%**	**0.011**	**5.000**	**1.568**	**15.942**
Yes	40	35.3	8	12.7	48	100				
No	10	50.0	10	50.0	20	100				

Secondary data, 2021-2023
Chi-square test for quantitative variables

DISCUSSION

In patients of the Indonesian National Police Mobile Brigade Corps at the RS Bhayangkara Tk. I Pusdokkes Polri Jakarta, shows the relationship between history of knee injuries with knee OA. There is a statistically significant or relevant result, as indicated by the *p* value of 0.011 < 0.05.

According to the Odds Ratio (OR) value, people with a history of knee injuries are at five times more likely to develop knee OA than those without such a history of knee injuries (OR = 5.000, 95% CI: 1.568-15.942).

The results of this study showed that patients with mild knee OA (Grade 1-3) had the highest number of 38 people followed by patients with severe knee OA (Grade 4) as many as 10 people. The findings of this inquiry align with those of research projects by de Lima Paulo et al., (2015) that it has been verified that the incidence of musculoskeletal injuries in police officers has a close relationship with the onset of musculoskeletal problems, one of which is post-traumatic osteoarthritis (PTOA).

The findings of additional studies thus support the findings of Snoeker et al., (2020) research, which indicated that knee injuries in young adults raise the chance of developing knee OA by almost six times, with the largest risk occurring following an ACL injury, meniscus tear, and intra-articular fracture.

This can be influenced by age and length of employment. The more frequent strenuous activities may reflect the risk of knee injury experienced. These results indicate the need for increased and more equitable coverage in physical training, screening with routine medical check-up (MCU) in police officers, especially those at high risk.

This study also shows the results that patients who have never experienced injury have a lower number than those who have experienced injury, namely 12 people with mild knee OA (Grade 1-3) and as many as 8 people with severe knee OA (Grade 4). This could be the case since pre-elderly (45 - ≤59) people made up the bulk of the studies age group which is one of the risk factors based on age. However, other factors such as genetic factors that were not examined in this study may also be a risk factor considering the multifactorial nature of knee OA.

This study it was found that respondents who had experienced previous knee injuries had the highest percentage, namely 48 people or 70.6%.

The findings of this investigation are comparable to those of Rahmanto & Aisyah, (2019) in this study got an Odds Ratio [OR= 5.82 (95% CI 2.54-13.35)] with a significant value less than α 5% (0.00 < 0.05). People with a history of knee injuries are five times more likely to develop knee OA than those without such a history, according to a statistically association between a history of knee injuries and patients at the Dinoyo Malang city health center who may have knee.

This study is also in line with Poulsen et al., (2019) female patients with an average age of 28 old who had an ACL injury, (35%), a meniscus tear with an average age of 38 years (36%), or both injuries together average age of 31 years, had Odds Ratio results 4.2 (95% CI 2.2-8.0; I2 = 92%), 6.3 (95% CI 3.8-10.5; I2 = 95%) and 6.4 (95% CI 4.9-8.3; I2 = 62%).

After an ACL injury, the risk of developing knee OA is approximately four times higher than in an untreated knee. Injury can reduce the strength of muscles to maintain body stability and thinning of cartilage in joints (Whittaker & Losciale, et al., 2022).

Injury can cause the cartilage in the joint to become thinner and the cartilage components to change, resulting in the joint being less resistant and more susceptible to damage (Sunbol et al., 2023).

The damage that occurs in cartilage is based on several mechanisms, one of the most important of which is the imbalance between matrix synthesis and degradation (Lam et al., 2017).

Then excessive pressure on the knee joint cartilage continuously (mechano-biological mechanism) will cause meniscus tears and ligament damage in the knee which causes changes in the structure of the knee joint due to non-physiological stress, so these things are thought to potentially increase the risk of knee OA (Gouttebarge et al., 2018).

Patients who have suffered severe have a much higher risk of acquiring knee OA. This highlights the importance of knee injury prevention programs and secondary preventive strategies in preventing or postponing the start of knee OA.

The study's biggest age group of respondents was 45 - ≤59 years old (pre-elderly), including 27 individuals with knee injuries and 18 individuals (66.2%) without knee injuries.

The findings of this investigation are consistent with studies carried by Supartono et al., (2018) at the RSU Al-Fauzan Jakarta. The dominance of the results of the study was patients with an age range of 45 - ≤59 years (middle age). The aging process is associated with the appearance of knee OA due to the influence of the degenerative process (Ponvel, et al., 2019).

One of the primary risk factors that might lead to inflammation or swelling in the body's joints, particularly the knee joint, which worsens with age, is aging. In various studies, it is stated that the aging process can occur from the age of 40-45 years old depending on the individual's health condition (Hunter, 2019).

The musculoskeletal system will also alter with age, leading to sarcopenia, a progressive loss of muscle mass and strength. Sarcopenia is a process that begins around the age of 30 years onwards. Loss of muscle strength and mass increases pressure on certain joints such as the knee joint which is the support of the heaviest body weight and can cause a person to experience knee arthritis (Rahmanto & Aisyah, 2019).

However, this study's findings diverge from those of studies by Dhaifullah et al., (2023) and Wulandari et al., (2023), in these studies the percentage of female patients suffering from knee OA with an age range of 60-75 years old (elderly) has a higher percentage of results.

This difference may be due to the limited number of research samples, especially in the older age group. This is because the focus of the study sample was the active working age group. It may also be due to the perception that the symptoms felt by people with knee OA are symptoms that are commonly experienced by the elderly, which causes a low tendency to consult health facilities.

This study it was found that the respondents with the highest gender were women, namely with knee injury 24 people and without knee injury 11 people (51.5%).

The study's findings are consistent with earlier studies, including the study of Supartono, et al., (2018) and Poulsen, et al., (2019) which showed a high incidence of knee OA in women compared to men having more prevalence. The same research results were also found in a study conducted by Soeryadi, et al., (2017) at the RSUP Prof. Dr. R. D. Kandou Manado in the period January-June 2017 with the percentage of knee OA sufferers in women reaching 70.4%.

Nevertheless, the findings of this study differ from those of research carried out by Rahmanto & Aisyah, (2019) that the risk of knee OA is likely to be higher in men with an age range of 30-59 years old. This difference may be due to the uneven distribution of samples based on sex.

Based on existing theories and studies, women are consistently shown to have a high risk of knee OA, even closely associated with a higher risk of narrowing of the joint gap. This can occur due to hormonal factors or differences in the anatomical structure of bones in women that are different from men (Supartono, et al., 2020).

One of the reasons why women are more likely than males to develop knee OA is that they have thinner patellas and smaller femur bones (Maia, et al., 2023).

Furthermore, a decrease in estrogen, which are thought to protect joint cartilage, contribute significantly to the development of knee OA. The hormone will decline in women between the ages of 50 and 80 years old, particularly when they approach the post-menopausal stage.

A decrease follicle stimulating hormone (FSH) and luteinizing hormone (LH), which are produced by the pituitary gland, may cause the ovaries to become less sensitive. As a result, the ovaries release less estrogen and progesterone, and eventually ovulation stops (Poulsen, et al., 2019).

Another factor that may increase the risk of women suffering from knee OA more than men is the awareness to consult health facilities which tends to be higher in women than men. For example, injuries experienced by men such as sprains, dislocations, and even fractures are often ignored and considered not serious.

Then the differences that occur in this study also do not rule out the influence of genetics or initial handling and recovery at the time of knee injury. Additionally, the study's findings may be impacted by the complex nature disease of knee OA and the unequal distribution of samples across men and women.

This study revealed that the in this study it was found that the Headquarters Mobile Brigade Corps had the biggest number of responses from the Indonesian National Police Mobile Brigade Corps, with 28 individuals with knee injuries and 9 individuals (54.4%) without knee injuries.

The results of this investigation align with those conducted by Dhaifullah, et al., (2023) which used Kellgren-Lawrence data from Sanglah Denpasar Hospital to find a positive relationship between occupation and the severity of knee OA. The correlation coefficient (r) value of 0.417 indicates a strong relationship between the two (p = 0.001).

The occupation held by the sample in this study is a high physical activity occupation. The category includes the work units of the Indonesian National Police Mobile Brigade Corps, namely the Headquarters Mobile Brigade Corps and the Regional Police Mobile Brigade Corps. The uniforms used and the physical exercises performed are the same and routinely carried out every day. In their daily lives, members of the Indonesian National Police Mobile Brigade Corps perform a lot of strenuous physical activity and are at high risk of knee injuries.

In police institutions, there is a medical check-up (MCU) activity that is routinely carried out at least once a year in turn. This activity includes anamnesis, physical examination, and supporting examination which aims to monitor the health condition of Indonesian National Police so that they still have a healthy and prime body condition in the midst of high mobility.

However, periodic medical check-up facilities for Indonesian National Police are still uneven at all levels. In some of these activities, there are still differences in the examination, especially the examination of the health and function of the musculoskeletal system.

The injuries experienced can occur acutely and chronically or repeatedly, so the chance of musculoskeletal injury (MSI) in police officers force is classified as high risk. It is stated that the knee is the third most vulnerable part of the body to injury after the back and shoulder (Orr, et al., 2023).

This study it was found that respondents with mild knee OA severity (Grade 1-3) had the highest percentage, namely with knee injury 48 people and without knee injury 10 people (73.5%).

The findings of this investigation align with a research carries out by Supartono, et al., (2018) the distribution of knee OA patients based on the degree of severity of Kellgren and Lawrence the most is degree III (mild degree) and the lowest distribution is in patients with degree II (mild degree). Patients diagnosed with grade III knee OA are the largest group of all Kellgren-Lawrence degree divisions.

This study it was found that the respondents with the most types of knee injury history were ACL injury which had the highest percentage of 11 people were male and as many as 5 people were female (23.5%).

The findings of this study support Wang, et al., (2020) research, which found that individuals with a history of ACL injury are more likely to develop post-traumatic osteoarthritis (PTOA) due to the complex nature of the illness and the possibility of a chronic, progressive condition.

It does not, however, rule out the potential that individuals with a history of knee injuries may be more susceptible to PTOA if they also have a history of hamstring or patella injuries, meniscus tears, femur fractures, patella dislocations, or ruptures of the patellar tendon (Maia, et al., 2023).

Based on the research of Dilley, et al., (2023), PTOA is a multifactorial condition, may develop as a result of damage that impairs function and results in discomfort from inflammation in the affected region. Since the knee is the body's heaviest support, PTOA frequently develops there. Despite the fact that everyone may experience it, PTOA primarily affects younger people and can be brought on by trauma or accidents related to demanding activities like sports or military service.

This study will have important implications to manage the health of the Indonesian National Police Mobile Brigade Corps members` who has a high risk of sustaining knee injuries and developing osteoarthritis. These findings will assist in developing prevention programs, better rehabilitation protocols, early detection programs which are going to improve individual quality of life and also ensure better contribution at the operational responsibility of the institution.

CONCLUSION

There were statistically significant correlation between knee injury history with degree of osteoarthritis of knee among members of the Indonesian national police mobile brigade corps. History of knee injury was associated with a 5-fold risk of developing knee OA, with the highest risk occurring for anterior cruciate ligament (ACL) injuries. Such findings convince that preventive or rehabilitative strategies which would mitigate the risk for OA should be considered in high physically active jobs.

The study enhances understanding of the relationship between knee injury history and OA severity which have implications for high-activity populations such as the Indonesian National Police Mobile Brigade Corps. It incorporates the development of targeted prevention and rehabilitation strategies to mitigate OA risk, and emphasizes the importance of early detection and effective post-injury care for at-risk population cohorts.

Limitations of this study include its retrospective, hospital-based design which may not be generalizable to the population, and a relatively modest sample size which substantially limits generalizability. Now, this does not take into consideration genetics, diet, or medical history that also may play a role in one's risk for osteoarthritis. In addition, long-term data regarding the progression of osteoarthritis following knee injury were not comprehensively examined.

Future studies should utilize larger, more diverse samples for improved generalizability and prospective cohort designs to capture wider populations. Genetic, nutritional, and medical elements could also provide a more holistic picture of the risk for developing osteoarthritis. Long-term data are

needed to determine whether knee injuries lead to progressive osteoarthritis and, if so, what interventions would prevent this trajectory.

ACKNOWLEDGEMENTS

We are grateful to the Head of Function Development Department RS Bhayangkara Tk. I Pusdokkes Polri Jakarta, drg. Agustini Purwaningsih, Sp.Perio., M.M. for granting permission to carry out the research study on outpatients members of the Indonesian National Police Korps Brigade Mobil and all RS Bhayangkara Tk. I Pusdokkes Polri Jakarta who was involved in the smooth running of this research.

REFERENCES

de Lima Paulo, L. F., de Oliveira Ayala, C., Barroso Hirota, V., da Silva Paiva, L., de Alcantara Sousa, L. V., dos Santos Figueiredo, F. W., Pinheiro Bezerra, I. M., de Abreu, L. C., & Adami, F. (2015). Impact of Musculoskeletal Injury in Students of Police Academy: a Cohort Study. *International Archives of Medicine*, 1–9. https://doi.org/10.3823/1820

Dhaifullah, M. R., Meregawa, P. F., Aryana, I. G. N. W., & Subawa, I. W. (2023). Hubungan Usia, Jenis Kelamin, Dan Pekerjaan Terhadap Derajat Keparahan Penderita Osteoartritis Lutut Berdasarkan Kellgren-Lawrence Di Rsup Sanglah Denpasar. *E-Jurnal Medika Udayana*, *12*(1), 107. https://doi.org/10.24843/mu.2023.v12.i01.p18

Dilley, J. E., Bello, M. A., Roman, N., McKinley, T., & Sankar, U. (2023). Post-traumatic osteoarthritis: A review of pathogenic mechanisms and novel targets for mitigation. *Bone Reports*, *18*(December 2022), 101658. https://doi.org/10.1016/j.bonr.2023.101658

Gouttebarge, V., Aoki, H., & Kerkhoffs, G. M. M. J. (2018). Knee osteoarthritis in professional football is related to severe knee injury and knee surgery. *Injury Epidemiology*, *5*(1). https://doi.org/10.1186/s40621-018-0157-8

Hunter. (2019). Osteoarthritis. *The Lancet*. https://doi.org/https://doi.org/10.1016/S0140-6736(19)30417-9

Lam, K. C., Thomas, S. S., Valier, A. R. S., McLeod, T. C. V., & Bay, R. C. (2017). Previous knee injury and health-related quality of life in collegiate athletes. *Journal of Athletic Training*, *52*(6), 534–540. https://doi.org/10.4085/1062-6050-50.5.01

Lentz, L., Voaklander, D., Gross, D. P., Guptill, C. A., & Senthilselvan, A. (2020). A description of musculoskeletal injuries in a canadian police service. *International Journal of Occupational Medicine and Environmental Health*, *33*(1), 59–66. https://doi.org/10.13075/ijomeh.1896.01454

Maia, C. R., Annichino, R. F., de Azevedo e Souza Munhoz, M., Machado, E. G., Marchi, E., & Castano-Betancourt, M. C. (2023). Post-traumatic osteoarthritis: the worst associated injuries and differences in patients' profile when compared with primary osteoarthritis. *BMC Musculoskeletal Disorders*, *24*(1), 1–9. https://doi.org/10.1186/s12891-023-06663-9

Orr, R., Canetti, E. F. D., Pope, R., Lockie, R. G., Dawes, J. J., & Schram, B. (2023). Characterization of Injuries Suffered by Mounted and Non-Mounted Police Officers. *International Journal of Environmental Research and Public Health*, 1–12.

Ponvel, P., Ajit Singh, D. K., Soon, M. S., Kamsan, S. S., & Ahmad, M. A. (2019). Comparison of Physical Performance between Older Adult Fallers with and without Knee Osteoarthritis. *Jurnal Sains Kesihatan Malaysia*, *17*(02), 147–155. https://doi.org/10.17576/jskm-2019-1702-17

Poulsen, E., Goncalves, G. H., Bricca, A., Roos, E. M., Thorlund, J. B., & Juhl, C. B. (2019). Knee osteoarthritis risk is increased 4-6 fold after knee injury-a systematic review and meta-analysis. *British Journal of Sports Medicine*, *53*(23), 1454–1463. https://doi.org/10.1136/bjsports-2018-100022

Rahmanto, S., & Aisyah, K. (2019). Hubungan Riwayat Cidera Lutut Terhadap Pasien Yang Berpotensi Osteoarthritis Lutut Di Puskesmas Dinoyo Kota Malang. *Jurnal Fisioterapi Dan Rehabilitasi*, *3*(1), 20–29. https://doi.org/10.33660/jfrwhs.v3i1.31

Snoeker, B., Turkiewicz, A., Magnusson, K., Frobell, R., Yu, D., Peat, G., & Englund, M. (2020). Risk of knee osteoarthritis after different types of knee injuries in young adults: A population-based cohort study. *British Journal of Sports Medicine*, *54*(12), 725–730. https://doi.org/10.1136/bjsports-2019-100959

Sunbol, K., aldahan, B. Al, Mubarak, H. Al, Bozaid, Z., Alqahtani, I., Basarwan, A., Alabbadi, A., Alghamdi, T., Akkasi, H., Redha, H., & Almassaud, H. (2023). Inflammation Process, Outcome and Prevention of Post-Traumatic Osteoarthritis. *Journal of Healthcare Sciences*, *03*(01), 19–24. https://doi.org/10.52533/johs.2023.30104

Supartono, B., Amalia, R., Satya, I., & Wiyono, S. (2018). Relation Between Osteoarthritis Grading Scale with Cartilage Ultrasonographic in Knee Osteoarthritis Patient at RSU Al Fauzan Period of 2016-2017. *Journal of Medical - Clinical Research & Reviews*, *2*(6), 1–4. https://doi.org/10.33425/2639-944x.1066

Supartono, B., Rahmadati, S., & Agustini, D. (2020). The Role of PRP and Its Platelet Concentration in Improving WOMAC Score on Early-Stage Knee Osteoarthritis (OA) Patients. *Orthopaedic Journal of Sports Medicine*, *8*(5_suppl5), 2325967120S0010. https://doi.org/10.1177/2325967120s00108

Supartono, B., Sendi, P., & Dapatkah Osteoarthritis Lutut Disembuhkan. (2018). RSON Menyongsong Asian Games 2018. *Media Informasi RSON Rumah Sakit Olahraga Nasional Edisi Keempat - Tahun II*.

Wang, L. J., Zeng, N., Yan, Z. P., Li, J. T., & Ni, G. X. (2020). Post-traumatic osteoarthritis following ACL injury. *Arthritis Research and Therapy*, *22*(1), 1–8. https://doi.org/10.1186/s13075-020-02156-5

Whittaker, J. L., Losciale, J. M., Juhl, C. B., Thorlund, J. B., Lundberg, M., Truong, L. K., Miciak, M., Van Meer, B. L., Culvenor, A. G., Crossley, K. M., Roos, E. M., Lohmander, S., & Van Middelkoop, M. (2022). Risk factors for knee osteoarthritis after traumatic knee injury: A systematic review and meta-analysis of randomised controlled trials and cohort studies for the OPTIKNEE Consensus. *British Journal of Sports Medicine*, *56*(24), 1406–1421. https://doi.org/10.1136/bjsports-2022-105496

Wulandari, N. H., Purwatama, G., Septiara, R., Fazira, E. R., Pabrizadinata, M. I. J., Rahayu, U. B., & Pristianto, A. (2023). Angka Kejadian Dan Edukasi Penangana Nyeri Lutut Akibat Osteoarthritis Pada Wanita Komunitas Pkk Di Desa Pabelan. *Jurnal Warta Desa (JWD)*, *5*(3), 213–219. https://doi.org/10.29303/jwd.v5i3.266