

## Work-related musculoskeletal symptoms among Traffic police: A Review

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### ABSTRACT

Workplace environment plays an important role in the health of the working population. The risk of adverse effects on health becomes high with the increase in duration of exposure to occupational hazards. Traffic police personnel are vulnerable to such situations. They undergo various hazards ranging from road injuries, physical hazards, biological hazards, chemical hazards, ergonomic hazards and psychological stress while they are at work. They have to keep on standing on same place throughout the duty hours, which also increases the risk of musculoskeletal problem. There have been very few researches to explore the situation of work-related musculoskeletal symptoms in traffic police. Recently, work-related musculoskeletal symptoms were the main cause of sickness absenteeism, reduction in productivity, and chronic occupational disabilities in traffic police have received much attention. Thus, this review has been designed to help the health care professional and occupational health and safety professionals to know the most prone body areas for Musculoskeletal Disorders so as to plan for ergonomic modification and improve quality of life of Traffic Police Personnel. It will also help in uplifting musculoskeletal health for Traffic Police Personnel.

**Key words:** Ergonomic hazards; Traffic Police Personnel; Work-related Musculoskeletal Symptoms

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### Introduction

Work-related musculoskeletal disorder has been described as one of the major problems in many industrialized countries. It is considered as a major occupational health problem in working population which results in reducing working capacity and productivity. The risk of health hazard depends upon the occupational environment as well as severity and the duration of exposure. In this regard, traffic police personnel (TPP) are the vulnerable group as they get engaged in managing the busy street for longer hours in adverse conditions.<sup>1</sup> Rapid globalization and industrialization have resulted in the emergence of occupational health related problems. Health is a way

of functioning within one's environment. It is largely affected by work conditions so workplace environment plays an important role in man's total environment.<sup>2</sup>

The job also requires traffic police to keep on standing during their entire duty hours which puts them at risk for serious musculoskeletal disorders. In addition to this, static position also makes them vulnerable to ergonomic hazards. Many cities have been facing the problems of traffic congestion due to the increased number of vehicles which has made the duty of TPP hard and complex one. While managing complex traffic system, traffic police encounters with occupational hazards related with their duties and responsibilities. TPP go through various hazards ranging from road traffic accidents, physical hazards, biological hazards, chemical hazards, ergonomic hazards and psychological stress while managing the traffic. They

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remain equally vulnerable to many biological agents, viruses, bacteria, parasites, fungi, moulds and organic dusts. This increases the risk for viral and bacterial infection, allergies and respiratory diseases etc.<sup>3</sup>

They are also exposed to physical factors such as noise, vibration, radiation which also affects their health. Noise induced hearing loss is a common health problem among TPP while working in a busy and congested road. Exposure to heat and light makes them vulnerable to heat sensitivities and light exposure related complications. Oxides of carbon, sulfur, nitrogen, lead and benzene are the major chemicals found in the air which has serious effect on health. TPP equally suffer from psychological stress caused by hectic nature of the work, long duty hours, vehicular congestion and their monotonous nature of work. Taking all things into consideration, it is highly likely that TPP may suffer from cardiovascular disorder as well.<sup>4-7</sup>

Among various occupational hazards, musculoskeletal disorder (MSD) is one of the most common work-related health problems. The work-related musculoskeletal disorder (WRMSD) is defined as “a wide range of inflammatory and degenerative disease conditions that result in pain and functional impairment affecting the neck, shoulders, elbows, wrists and hands”.<sup>8</sup> The prevalence of WRMSD has been reported high among TPP and is related to duration of working hours, number of years worked, awkward and static postures, repetition of movements, uncomfortable posture, vibration, manual handling etc. This leads to strain on the joints and various disorders of the musculoskeletal system which is the main cause of absenteeism from the workplace.<sup>9</sup>

To ensure regular movement of vehicles on the busy road, the traffic police personnel play an active role.<sup>10</sup> They are the most susceptible group to develop work-related musculoskeletal symptoms (WRMSS). WRMSS is defined as any trouble (ache, pain or discomfort) in nine topographic regions of the body viz: neck, shoulder, elbow, wrist, upper back, low back, hips/thigh, knee, and ankle/feet.<sup>11</sup>

Among WRMSS, low back pain (LBP) is the most common health problem all around the world. It is a major cause of disability among workplaces as well.<sup>12</sup> According to World Health Organization (WHO) report 2013, low back pain was responsible for being away from work and for visiting a doctor. About 70% to

80% of the World's population has at least one episode of low back pain in their life time.<sup>13</sup> Due to lack of awareness about the proper posture, low back pain is the most common symptom among workers. It is also a leading cause of sickness absenteeism, reduction in productivity, and chronic occupational disability.<sup>14</sup>

### **Mechanism of Development of Work-related Musculoskeletal Disorders**

WRMSDs are painful disorders of muscles, tendon and ligaments. It is mostly due to repetitive work activities and awkward working postures. Common types of soft tissues affected are muscles, tendons and nerves. Lactic acid released by blood during muscle contraction gets accumulated in the muscle and irritates the muscle and results in muscle pain.<sup>15</sup>

Tendon is a strong fibrous collagen tissue attaching muscle to bone. It is flexible but inelastic. It is classified as tendon with sheaths (found in hands and wrist) and without sheaths (found in shoulder, elbow and forearm). The sheaths contain cells that produce a fluid. This fluid acts as lubrication between tendon and muscle. Repetitive and excessive movement of the tendon prevents lubrication and may not produce enough fluid for the lubrication which results in inflammation and swelling between tendon and sheath. Recurrent inflammation prevents tendon movements due to formation of fibrous tissue which thickens the sheath. Awkward posture and repetitive motion are the important risk factors in which tendon without sheath can get more exposed. The tendon which gets tensed repeatedly for a long time will get thickened and inflamed (tendonitis). Bursa is a sac located between tendons and bones. It is filled with fluid which acts as a medium for lubrication. When the tendon tends to thicken, it results in friction and bursitis.<sup>15</sup>

Nerve is a bundle of fibers responsible for transmission of sensory and motor information from one part of body to another. It also transmits information about pain, touch and temperature and control bodily function. The nerves are surrounded by tendon, ligaments and muscles. Due to repetitive motion and awkward postures, it gets swollen and compressed and results in muscle weakness and numbness.<sup>15</sup>

### **Risk Factors of Work-Related Musculoskeletal Symptoms**

**Repetition of Movement:** Due to the nature of work, traffic police have to use same muscles and tendons throughout the day, which is responsible for fatigue and

injuries. Repetitive movements are hazardous when same joints and muscle groups are involved frequently, quickly and for a long period. Repetitive work in an awkward position is the most important risk factors for development of musculoskeletal problems.<sup>16</sup>

**Awkward and Static Postures:** An awkward posture refers to significant deviation (bent, extended or flexed) of various parts of the body (limbs, joints, back) from straight or neutral position. When the position of body parts deviate significantly from neutral, the joints are more susceptible to injuries and the muscles have less capacity for exerting force. Risk of MSD is increased when joints are worked outside the neutral position repetitively for sustained periods without proper recover time.<sup>17</sup>

**Static Postures** is defined as physical exertion due to same position or posture held for prolonged period. These types of exertions put increased load or forces on the muscles and tendons, which contributes to fatigue. If workers have long-term static postures, they will get their shoulder muscles tensed while the hand work without the opportunity to rest. This type of repeated static posture may lead to injuries.<sup>18</sup>

**Prolonged Standing:** It may result in fatigue and discomfort in the legs. It leads to the foot problems and varicose veins. Muscles have to hold the trunk, neck and shoulders in a fixed position while standing for prolonged period. This squeezes the blood vessels in the muscles, which reduces blood supply. Insufficient blood supply accelerates fatigue and makes the muscles prone to injury.<sup>16</sup>

**Age:** With increased age, repeated exertions and awkward postures, exposure to different hazards, people are more vulnerable to back, shoulder and wrist joint problems. So, MSD diagnosis is likely to develop in the later part of life.<sup>16</sup>

**Cigarette Smoking:** Cigarette smoking has progressive effect on the musculoskeletal system. Similarly, nicotine in cigarette slows the production of bone forming cells. Smoking also decreases the absorption of calcium from the diet which is necessary for bone mineralization. So, smokers are prone to develop fragile bone. Smoking is associated with more bone fractures and slower healing and is associated with up to a 40% increase in the risk of hip fractures among men. Smoking has a negative impact on bone mineral density, and lowering the level of vitamin D, changing hormones level and body mass. It also

favors the onset of rheumatoid arthritis and back pain. Smokers and ex-smokers experience 60% more pain in the back, neck and legs and increase in lower back pain.<sup>17</sup>

**Alcohol Consumption:** Excessive alcohol interferes with the balance of calcium and interferes with the production of vitamin D. Similarly, it causes testosterone deficiency in male and estrogen in female and hormone deficiency results in less production of osteoblasts and increases the risk of osteoporosis. Also, cortisol level may be increased in alcoholic which decrease bone formation and increase bone breakdown. Myopathies is also common in alcoholics which could increase susceptibility of fall, resulting in osteoporotic fractures.<sup>17</sup>

**Body Mass Index (BMI):** The BMI value indicates the amount of body fat a person has. Individuals with a BMI value of 25 or greater are considered overweight, and individuals with a BMI of 30 or greater are considered obese.<sup>17</sup> There was potential association between a workers BMI and the occurrence of musculoskeletal symptoms in one of the study.<sup>19</sup> Overweight workers experienced symptoms in the upper and lower extremities, while obese workers showed symptoms in the neck/shoulder, back, and upper and lower extremities. Obese employees had a greater odds ratio (OR) than overweight workers, suggesting a positive increasing relationship between BMI and musculoskeletal symptoms.<sup>20</sup>

**Prolong Duration of Working Hours:** The job requires traffic police to keep on standing position during the entire duty hours. This standing posture for a long time may increase the risk of musculoskeletal disorders. Standing for long hours in a static position also makes them vulnerable to ergonomic problems.<sup>21</sup> Prolonged standing at work has been shown to be associated with a number of health outcomes, such as lower back and leg pain, fatigue, discomfort, and pregnancy complication. Major health risks identified were chronic venous insufficiency, musculoskeletal pain of the lower back and feet, pre-term birth, and spontaneous abortion. Back pain was the most reported musculoskeletal disorder followed by neck and shoulder discomforts.

Outcomes of Work-Related Musculoskeletal Symptoms

**Sickness absenteeism:** Among various occupational hazards, work-related musculoskeletal disorders are important causes of inability to work which leads to sickness absenteeism in traffic police. Sick leave

absenteeism is also an important factor of productivity loss.<sup>22</sup> Due to working in uncomfortable postures, inappropriate lifting technique, repetitive movement of hands while giving traffic signal, working for prolonged periods without rest and poor work station, impose strain on joints leads to musculoskeletal discomforts in traffic police, which are important causes of work-related sickness absenteeism.<sup>23</sup>

**Reduction in Productivity:** Health problem may also affect work ability, causing reduced productivity while the worker is still on the job. Hence, both absenteeism and presentism should be taken into consideration when musculoskeletal disorders are calculated. Work related musculoskeletal disorders are the impairments of the body structures which are caused primarily by the performance of work and the effects of workplace environment in which work is carried out. These disorders are gradual in development and can interfere with activities at work which leads to reduced productivity, sickness absence, injuries and chronic occupational disability.<sup>24</sup>

## Discussion

Musculoskeletal disorder is a common health problem all over the world; affecting people in all occupations.<sup>25</sup> These disorders have caused a significant human suffering as well as reduced working capacity and decreased productivity.<sup>26</sup> A study which was done back in 1995 A.D in one of the major city of China estimated that 1.2 million men and women were suffering from musculoskeletal symptoms caused by work. MSD most commonly affected lower back, neck, shoulder and upper back, with prevalence rates of 28.0%, 24.0%, 18.6% and 15.5% respectively. Among workers suffering from MSD, about 50% reported pain or discomfort in less than one month duration.<sup>27</sup> One of the researches which was done on occupational health in the UK, the Netherlands and the USA in 2015 revealed that disability and sickness absenteeism was the major outcome of musculoskeletal disorders. In most industrialized countries, almost 50% of all workers compensation costs were due to musculoskeletal disorders. Moreover, recent reviews have also concluded that almost 50% of all reported occupational illnesses are due to WRMSS.<sup>28</sup> Similarly, a study conducted in Europe in 2008 also revealed that WRMSS was the main cause of absenteeism from the workplace.<sup>29</sup> We can conclude that sickness absenteeism and occupational disability as the major outcomes of work related musculoskeletal disorders.

A cross-sectional study conducted on 40 traffic police from Comilla district in Dhaka, Bangladesh (2013) to identify the prevalence of low back pain among traffic police showed that 80% of traffic police suffered from low back pain. Working status, working posture, body type (BMI), cigarette smoking, diabetes, working period (years) were the common risk factors for the development of low back pain.<sup>24</sup> Another similar study which was done in Ahmadabad City of India (2015) showed that 62.65% of traffic police were having joint problems and the most common was burning sole (43.32%), followed by pain in the knee joint (32.36%), back pain (20.33%), and others (17.84%).<sup>30</sup> The study done by Satish et al. in 2015 on work related musculoskeletal symptoms in 250 traffic police in Mumbai showed that the lower back was the major body region affected. The major working posture for traffic police was standing. While standing, the centre of gravity is usually in the hip and waist area. This means that while standing hip carries most of the body weight and prolonged standing may cause fatigue of muscles around the hip. As a result, the lower back assumes a severely arched position to allow the weight to be distributed on the back, resulting into lumbar strain causing back pain.<sup>31</sup> Recently, cross-sectional study was done in Lahore, Pakistan (2018) in 204 male traffic police warden to find out the prevalence of Musculoskeletal pain. The study showed that the prevalence of MSK pain was 65.7% in which leg pain prevalence was highest (38.8%) followed by lower back (38.1%), shoulder(33.6%), knee (11.2%), arms/hands (6.7%), foot (6.7%), neck (6.7%) and 4.5% in upper back. Inclusion criteria were work related MSK pain, male, road traffic wardens, age 25-50 years and Lahore city. Exclusion criteria were infection, tumor, trauma, recent fracture, female, computer user wardens/office worker wardens. Most participants had moderate pain (61.2%), 20.1% have mild pain and only 18.7% have severe pain. Maximum participants had pain during 31-35 years of age. This study showed most of the traffic police warden (TPW) experienced leg pain instead of low back pain which may be due to working posture of TPW. During standing, the center of gravity is usually in the waist and hip area, so on standing hip carries most weight of the body. Prolonged standing cause muscle fatigue around the hip resulting into low back pain and also leg pain.<sup>32</sup> Similar study design from Mumbai area among 270 traffic police concluded that MSK pain was mostly common during 41-50 years of age.<sup>31</sup> Furthermore, high prevalence of low back

pain was found in Canadian police force (54.9%) who drove motor vehicles than the general population, and among other police officers, 1-year prevalence rate of between 44% and 62% had been reported.<sup>33</sup> In that study a random sample of 1002 members of the Royal Canadian Mounted Police were included to determine their experience with low back pain. Above studies showed that low back pain is the most common site for development of work-related musculoskeletal symptoms in traffic police. The common cause might be standing for prolonged periods, long duty hours and the nature of the work.

Centemeri et al. in 2005 conducted a study on stabilometric parameters associated with musculoskeletal diseases in a group of traffic policeman found that cervico-brachial pain, low back pain and sciatica as the most common symptoms.<sup>34</sup> Likewise a study done in a Metropolitan City Maharashtra, India in 2015 on male traffic police found that 50.75% of TPP had symptoms related to gastrointestinal tract, 37.31% subjects were having musculoskeletal symptoms (joint pain, backache, neck pain, cramps in calves, pain in heels, pain in lumber regions), 14.92% had chest pain, 9% had skin problems, 8% had respiratory problems and 6% suffered from dental problems. This study showed musculoskeletal disorder as the second most common cause in TPP.<sup>35</sup> Similar study done by Satopathy et al. (2009) on health status of Traffic Police Personnel in Brahmapur City, Orissa in India also observed MSDs as the second leading cause of work-related occupational hazards. They observed that 43.75% had anemia, 27.08% had MSDs, 25% suffered from hypertension, 19% had eosinophilia. Only 16% of the respondents had respiratory problems.<sup>1</sup> Likewise the study done by Patel et al (2014) on "Global review of studies on Traffic police with special focus on Environmental Health Effects" showed correlation between atmospheric pollution and some possible outcomes like ergonomic impact, damaged oral health, hearing loss, traffic injuries, personal protective equipments (PPEs), reproductive effects in traffic policemen wives, and vascular inflammatory reactions in traffic policemen.<sup>36</sup>

Burton et al. in 1996 revealed that physical stress as one of the occupational risk factors for low LBP among police officers managing traffic which often leading to increased sickness absenteeism.<sup>37</sup> So, *stress* can be responsible for a number of *physical* symptoms, including muscle tension and *back pain*.

A study which was done on "Factor affecting the Musculoskeletal Symptoms of Korean Police Officers" in 2014 in 353 subjects showed that the incidence of pain was 44.2% in the shoulder, 41.4% in the waist, 31.2% in the neck, 26.1% in the legs/foot, 16.7% in the hands/wrist/fingers and 14.7% in the arms/elbows which concluded the global burden of musculoskeletal disorders in TPP. In addition to that, the comparative risk of the relevant part which was analyzed showed that the shoulder had a 4.87 times higher risk in police lieutenants compared with those under the rank of corporal and 1.78 times higher risk in people with chronic diseases than those without chronic diseases.<sup>38</sup> Recent study done in 384 traffic police in Pakistan also showed that 69% had upper extremity pain and 54% had radiating pain to other regions. Upper extremity pain in this study was due to their working hours which were more than 11 hours a day. Due to long working hours 66.1% felt fatigued after their duty hour. These two studies showed that long duty hour as a major risk factor for occurrence of upper extremity pain in police officers.<sup>39</sup>

A comparative study on occupational stress and work ability among the police officers (n=191), doctors (n=288), teachers (n=343) in 2004 in China found differences in occupational stress and the strain between the groups which was statistically significant ( $p < 0.05$ ), and the score of the police officers were higher than that of the doctors and teachers ( $p < 0.05$ ). But the sample of police officers was lower than those of teachers and doctors.<sup>40</sup>

The occupational Health Department of driving police forces in the UK in 1998 did a study to find a risk factor for sickness absenteeism due to low back pain. The main risk factors was among the people who were tall, used to wear bulky clothes, involved in a lot of weight lifting activities and driving for a long hours. These risk factors were responsible for the development of LBP in driving police which resulted sickness absenteeism.<sup>41</sup>

Ergonomics is the science of fitting workplace conditions and job demands to the capability of the working population.<sup>42</sup> The objective of ergonomics is to reduce stress and eliminate injuries and disorders associated with the overuse of muscles, bad postures and repeated tasks. Workers who spend many hours at a workstation may develop ergonomic-related problems resulting in musculoskeletal disorders (MSDs).<sup>43</sup> Workers in many industries and occupations are exposed to risk such as lifting heavy loads, bending, pushing and pulling heavy

loads, repetitive movements, poor posture. Exposure to these risk factors increases the possibility of musculoskeletal injuries. According to the US Bureau of labor statistics in 2013, MSD cases accounted for 33% of all worker injury and illness.<sup>44</sup> A review of the literature on occupational health and safety issues of police officers which was done in Canada in 2004 indicates that police face physical, chemical, biological, ergonomic, and psychosocial hazards. Among ergonomic risks, police officers are more susceptible to back problems. Although the information is limited, low back pain seems to be a common ailment influencing the lives of police officer.<sup>45</sup>

Work-related musculoskeletal symptom is common in other professions as well. A cross-sectional study which was also done in 2014 in Uganda among 741 nursing professionals to assess the work-related musculoskeletal disorders and associated risk factors using the Dutch Musculoskeletal and Nordic Musculoskeletal questionnaires showed that the 12 months period of MSD at any body site was 80%, the most common body site was low back (61.9%), followed by feet and ankle (38.1%), knee (37.1%), neck (36.9%), upper back (35.8%) and the shoulder (32.6%).<sup>46</sup> It showed that working in bent or twisted postures, pushing or pulling heavy loads were significantly associated with MSD<sup>46</sup>. Similarly, a cross-sectional study which was done on dentists to find out the prevalence of MSDs using Nordic Musculoskeletal questionnaires showed that the prevalence of MSDs for the different body parts in the past 12 months as: neck (75.9%), shoulder (58.6%), upper back (56.9%), low back (48.3%), wrist (44.8%), knee (44.8%), femur (10.3%) and ankle (6.9%).<sup>47</sup> In the dentist profession, most of them had to bend their trunk so, the most commonly affected body parts was neck. From the above findings it can be concluded that this work-related musculoskeletal symptom is common in various occupation. The nature of the working environment and the type of job plays an important role in the occurrence of WRMSS.

Research which was done on the global burden of diseases and injuries in Colombia (1994) showed that

annual incidence of MSD was estimated in almost 1/3<sup>rd</sup> of all occupational diseases. MSDs were the most frequent occupational disease affecting workers throughout the World.<sup>48</sup> A study which was conducted in Calicut, India in 2013 on "Pattern of occupational injury and its effects on the health" in 900 male police officers, 20% policemen were reported to be injured. The main cause of injury was encounters with the criminals (52.7%) followed by accidents (35.5%). Common type of injury was laceration (43.2%) followed by fractures (36.7%). The injury group had higher prevalence of smoking, consumption of alcohol, dissatisfaction with their job and joint pains and body aches.<sup>49</sup>

Review of prevalence of work-related musculoskeletal symptoms and associated risk factors is shown in table 1.

## Conclusions

In the light of these studies, it is possible to conclude that traffic police are facing the problem of work-related musculoskeletal symptoms; most common being the low back pain. Age, working status, working posture body type (BMI), cigarette smoking, alcohol consumption, diabetes, working period (years), physical stress were the common risk factors for occurrence of WRMSS in TPP. Likewise tall people, wearing bulky clothes, involved in weight lifting activities, driving for a long hours are also other important risk factors for the development of LBP. Prolonged standing, walking, uncomfortable posture, lifting heavy loads, frequent twisting was observed as ergonomics risk factors for occurrence of WRMSS. It can also be concluded that WRMSS is common in other professionals as well. All these are responsible for sickness absenteeism, reduction in productivity and chronic disability in TPP. Hence, periodic health examination, ergonomics modification, awareness campaign, occupational health and safety strategies will help to improve workplace environment and health of traffic police personnel. This review will also help the health care professional and occupational health and safety professionals to know the most prone body areas for MSDs so as to improve quality of life of TPP.

**Table 1:** Prevalence of work-related musculoskeletal symptoms and associated risk factors

| Author(year)            | Country           | No of respondents                                  | Parts of the body                                       | Risk factors   |
|-------------------------|-------------------|--|---|--|
| Brown et al. (1988)     | Canada            | 1002 police officer                                | Lower back  | Wearing duty belt, patrol car seat   |
| Gyi and potter (1998)   | United Kingdom    | 80 traffic car drivers and 91 general duty officer | Lower back  | Tall built, wearing bulky clothes, weight lifting activities, driving for long hours                 |
| Satopathy et al.(2009)  | India             | 48 traffic police                                  | Leg   | Prolonged standing hours, obesity  |
| Nazmul (2013)           | Bangladesh        | 40 traffic police                                  | Lower back  | Working status, working posture, body type (BMI), Cigarette smoking, diabetes, working period(years) |
| Cho et al. (2014)       | Republic of Korea | 353 police officer                                 | Shoulder, Waist, Neck, Leg/foot, wrist, elbow           | Age, repetitive motion   |
| Prajapati et al. (2015) | India             | 482 traffic police                                 | Knee, lower back, sole                                  | Prolonged standing hour, obesity, working period   |
| Satish et al.(2015)     | India             | 270 traffic police                                 | Lower back, upper back                                  | Working period, working posture(standing), obesity   |
| Gaurav (2015)           | India             | 67 traffic police                                  | Lower back, Neck, Calves, heels, lumber regions         | Overweight   |
| Fiaz et al. (2018)      | Pakistan          | 204 traffic police wardens                         | Leg, lower back, Shoulder, Knee, Arms/hands, foot, Neck | Working posture(Prolonged standing)  |
| Anmad et al. (2018)     | Pakistan          | 384 traffic police                                 | upper extremity   | working hours  |

## References

- Satopathy DM, Behera TR, Tripathy RM. Health Status of Traffic Police Personnel in Brahmapur City. *Indian Journal of Community Medicine.* 2009;34(1):71-2.
- Samuel AT. The influence of work environment on workers productivity: A case of selected oil and gas industry in Lagos, Nigeria. *African Journal of business management.* 2010;4(3):299-307.
- International Occupational Safety and Health Information Center. Occupational Hazard datasheets-Police/Law Enforcement Officer. Switzerland: International Occupational Safety and Health Information Center; 2000.
- Wongsurakiat P, Maranetra KN, Nana A, Naruman C, Aksornint M, Chalermpanyakorn T. Respiratory symptoms and pulmonary function of traffic policemen in Thonburi. *J Med Assoc Thai.* 1999;82(5):435-43.
- Tamura K, Jinsart W, Yano E, Karita K, Boudoung D. Particulate air pollution and chronic respiratory symptoms among traffic policemen in Bangkok. *Arch Environ Health.* 2003;58(4):201-7.
- Tripathi SR, Tiwari RR. Self-reported hearing quality of traffic policemen: A questionnaire-based study. *Indian Journal of Occupational and Environmental Medicine.* 2006;10(2):82-4.
- Karita K, Yano E, Jinsart W, Boudoung D, Tamura K. Respiratory symptoms and pulmonary function among traffic police in Bangkok, Thailand. *Arch Environ Health.* 2001;56(5):467-70.
- Vijay SA. Work- related musculoskeletal health disorders among the information technology Professionals in INDIA: A prevalence Study. *Int J Mgmt Res & Bus Strat.* 2013;2(2).
- Carayon P, Smith MJ, Haims MC. Work Organization, Job Stress, and Work-Related Musculoskeletal Disorders. *The Journal of the Human Factors and Ergonomics Society.* 1999;41(4):644-63.
- Deb S, Chakraborty T, Chatterjee P, Srivastava N. Job-Related Stress, Causal Factors and Coping Strategies of Traffic Constables. *J Ind Acad App Psychol.* 2008;34(1):19-28.
- Kuorinka I, Jonsson B, Kilbom A, Vinterberg H, Biering-Sorensen F, Andersson G, et al. Standardised Nordic Questionnaires for the analysis of musculoskeletal symptoms. *Appl Erg.* 1987;18(3):233-37.

12. Choobineh A, Tabatabaei SH, Tozihian M, Ghadami F. Musculoskeletal problems among workers of an Iranian communication company. *Indian J Occup Environ Med.* 2007; 11(1):32-6.
13. Charoenchai L, Chaikoolvatana A, Chaiyakul P. The relationship between health behaviour and pain scale in patients with low back pain in Thailand. *Southeast Asian J Trip Med Public Health.* 2006;37(5):1040.
14. Ebnezer J. *Essential of orthopedics for physiotherapists.* New Delhi, India: Jaypee brother's medical publishers (p) Ltd; 2003.
15. Canadian Centre for Occupational Health & Safety. *Work-related Musculoskeletal Disorders.* Canada: Canadian Centre for Occupational Health & Safety; 2014.
16. European Agency for Safety and Health at Work. *Work-related musculoskeletal disorders (MSDs): an introduction.* *Saf Heal.* 2007;1-9.
17. Keat A, Sofat N. Alcohol intake in rheumatic disease: good or bad. *Rheumatology.* 2002;41(2):125-8.
18. Abate M, Vanni D, Pantalone A, Salini V. Cigarette smoking and musculoskeletal disorders. *Muscles Ligaments Tendons J.* 2013;3(2):63-9.
19. Center for Disease Control and Prevention. *Work-Related Musculoskeletal Disorders (WRMSD) Prevention.* Atlanta, USA: Center for Disease Control and Prevention; 2013.
20. Viester L, Verhagen Evert ALM, Oude Hengel KM, Koppes LLJ, Van der Beek Allard J, Bongers PM. The relation between body mass index and musculoskeletal symptoms in the working population. *BMC Musculoskeletal Disord.* 2013;14:238.
21. Waters TR, Dick RB. Evidence of Health Risks Associated with Prolonged Standing at Work and Intervention Effectiveness. *Rehabilitation nursing : the official journal of the Association of Rehabilitation Nurses.* 2015;40(3):148-65.
22. Fekedulegn D, Burchfiel CM, Hartley TA, Andrew ME, Charles LE, Tinneyzara CA, et al. Shiftwork and Sickness Absence Among Police Officers: The BCOPS Study. *Chronobiology International.* 2013;30(7):930-41.
23. Körlin J, Alexanderson K, Svedberg P. Sickness absence among women and men in the police: a systematic literature review. *Scand J Public Health.* 2009 Jan 5;37(3):310-19.
24. Hasan MN. *Prevalence of Low Back Pain among the Traffic Police.* Bangladesh, Dhaka: Bangladesh Health Professions Institute; 2013.
25. Hafzi MIM, Rohayu S, Noor Faradila P, Wong SV. Prevalence and risk factor of musculoskeletal disorder of motorcyclists. *Asia pacific symposium on advancements in Ergonomics and safety.* 2011:5-6.
26. Ndivhudzannyi EM. *The Study of Work-Related Musculoskeletal Disorders Amongst Workers in Brick Making Factory in South Africa.* Sweden: Lulea University of Technology; 2003.
27. Umi KMS, Karmegam K, Shamsul BMT, Imiza R, Ayuni NA. Interventions to Reduce Musculoskeletal Disorders among Motor Vehicle Workers : A Review. *Advances in Environmental Biology.* 2014;8(15):219-24.
28. Ghasemkhani M, Mahmudi E, Jabbari H. Musculoskeletal Symptoms in Workers. *International Journal of Occupational Safety and Ergonomics.* 2015;14(4):455-62.
29. Podniece Z, Taylor TN. *Work-related musculoskeletal disorders: prevention report.* European Agency for Safety and Health at Work. 2008;105.
30. Prajapati P, Modi K, Rahul K, Shah A. A Study Related to effect of job Experience on health of Traffic Police Personnel of Ahmedabad City, Gujarat, India. *International Journal of Interdisciplinary and Multidisciplinary Studies (IJIMS).* 2015;2(6): 127-33.
31. Satish S, Phadke D, Revati R, Iqbal R. Work Related Musculoskeletal Symptoms among Traffic Police: Cross Sectional Survey Using Nordic Musculoskeletal Questionnaire. *Int J Recent Res Interdiscip Sci.* 2015;04(2):26-9.
32. Fiaz MW, Ahmad AA, Munawar A, Rabia k, Fatina M. Prevalence of musculoskeletal pain in traffic police wardens of Lahore, Pakistan. *Rawal Medical Journal.* 2018;4(1)Jan-Mar:61-3.
33. Brown JJ, Wells GA, Trottier AJ, Bonneau J, Ferris B. Back pain in a large Canadian police force. *Spine.* 1998;23(7):821-7.
34. Centemeri R, Vercellino R, Taborelli S, Latocca R, De Vito G, Molteni G. Stabilometric parameters associated with musculoskeletal diseases in a group of traffic policemen. *G Ital Med Lav Ergon.* 2005;27(2):180-3.
35. Gaurav BR. Morbidities Among Male Traffic Police Personnel In a Metropolitan City. *International Journal of Scientific Research.* 2015;4(11):510-11.
36. Patil RR, Chetlapally S, Bagavandas M. Global review of studies on traffic police with special focus on environmental health effects. *International Journal of Occupational Medicine and Environmental Health.* 2014;27(4):523-35.
37. Burton AK, Tillotson KM, Symonds TL, Burke C, Mathewson T. Occupational risk factors for the first-onset and subsequent course of low back trouble. A study of serving police officers. *Spine.* 1996;21(22):2612-20.
38. Cho TS, Jeon WJ, Lee JG, Seok JM, Cho JH. Factors affecting the musculoskeletal symptoms of korean police officers. *J Phys Ther Sci.* 2014;26(6):925-30.
39. Ahmad G, Tanveer F, Ahmad A, Gillani SA. Prevalence of upper extremity pain among traffic police, Lahore, Pakistan. *Rawal Medical Journal.* 2018;43(1):64-7.



40. Yang XW, Wang ZM, Lan YJ, Wang MZ. Compare the Occupational Stress and Work Ability among the Police-officers, Doctors and Teachers. *J Sichuan Univ (Medical Sci Ed)*. 2004;35(2):251-4.
41. Gyi DE, Porter JM. Musculoskeletal problems and driving in police officers. *Occup Med (Lond)*. 1998;48(3):153-60.
42. Bernard BP. Musculoskeletal disorders and workplace factors: a critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and lower back. Atlanta USA: Centers for Disease control and Prevention, National Institute of Occupational Safety and Health; 1997.
43. Centers for Disease Control and Prevention. Targeting arthritis: improving quality of Life for more than 46 million Americans, at-a-glance. Atlanta, GA: U.S. Department of Health and Human Services; 2008.
44. United States Department of Labour. Occupational Safety and Health Administration. United States: United States Department of Labour; 2000.
45. Parsons JRL. Occupational Health and Safety Issues of Police Officers in Canada , the United States and Europe: A Review Essay. 2004:1-42.
46. Munabi IG, Buwembo W, Kitara DL, Ochieng J, Mwaka ES. Musculoskeletal disorder risk factors among nursing professionals in low settings: a cross-sectional study in Uganda. *BMC Nurs*. 2014;13(1):7.
47. Ehsan R, Zahra J, Farzad Omid K, Farzaneh R. A Study on Job Postures and Musculoskeletal Illnesses in Dentists. *International Journal on Occupational Medicine and Health*. 2013;26(4):615-20.
48. Piedrahita H. Costs of Work-Related Musculoskeletal Disorders (MSDs) in Developing Countries: Colombia Case. *International Journal of Occupational Safety and Ergonomics (JOSE)*. 2006;12(4):379-86.
49. Thejus T, Jayakrishnan T, Meharoof R, Jeeja M C. Pattern of occupational injury and its effect on the health of male police officers in Calicut, India. *Ann Trop Med Public Health*. 2013;6(6):622-6.