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RELATIONSHIP BETWEEN LACTIC ACID LEVEL WITH LOW BACK PAIN (LBP) ON TAXI DRIVERS PEKANBARU

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Abstract

Low back pain (LBP) is an uncomfortable sensation in the form of acute pain in the fifth lumbar vertebra and first sacrum (L5-S1). Half of the workers have complained of LBP, with a prevalence of LBP of 60-80%. Driving a vehicle can cause the back muscles to contract excessively, producing insufficient oxygen to support ATP production. The muscles then switch to anaerobic metabolism with the end product, lactic acid. The accumulated lactic acid then stimulates the nociceptors causing LBP. The existence of a daily achievement target system also causes drivers to insist on being able to complete many trips in one day, so drivers often ignore rest and working hours. The relationship between lactic acid levels and the incidence of low back pain in taxi drivers X Pekanbaru. This study used an observational analytic method, a cross-sectional, with the sampling technique used was total sampling, tested statistically using fisher exact. There is a relationship between lactic acid levels and the incidence of low back pain in taxi drivers X Pekanbaru (p-value = 0.000). Lactic acid levels are associated with low back pain in taxi drivers X Pekanbaru.

Keywords: Lactic Acid; Low Back Pain; Taxi Driver.

Introduction

Low back pain (LBP) is an uncomfortable sensation in the lumbar to the sacral area that is felt clearly or vaguely and can be spread or localized (Lestari, Soesanto, & Wijayanti, 2021). The European Agency for safety and health at work 2000 states that LBP is back pain originating from work. Clinically it can be caused or exacerbated by work (Wanamo & Aschalew, 2017). LBP is the most common musculoskeletal disorder in more than two-thirds of the working population. This is the leading cause decrease in

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work efficiency due to absence from work, job turnover, work restrictions, low productivity, and job loss. This recorded as a socioeconomic impact on individuals, business organizations, and society (Rufa'i et al., 2015; Wanamo & Aschalew, 2017).

Professional drivers are at greater risk of experiencing LBP and various spinal disorders (Chen, Chang, Chang, & Christiani, 2005; Wanamo & Aschalew, 2017). Research conducted on the population in the United States and Canada obtained 1.6–2.0 times the incidence of LBP. LBP was experienced by half of the population of taxi drivers in Japan, China, America (Freburger et al.). In India and Taiwan, the problems faced by drivers are the same (Chen et al., 2005). In Pekanbaru in 2019, more than 60% of taxi drivers and bus drivers experienced LBP (Haristniani & Marten, 2020; Pratiwi, Waren, & Akbar, 2020). Developed countries reported similar observations in LBP and related spinal disorders with drivers. These include machine drivers, forklift truck drivers, bus drivers, farm tractor drivers, truck drivers, and other professional drivers (Al-Dubai, Qureshi, Noor hassim, & Rampal, 2013; Chen et al., 2005). Many physical factors at work (whole body vibration), posture, and prolonged sitting duration, other psychosocial factors are thought to play a role in LBP in professional drivers (Chen et al., 2005). Another important factor including age, driving time, driving duration (constant throughout the day), vibration, and frequent lumbar-vertebral rotation (Rufa'i et al., 2015).

The prolonged sitting can result in a cartilage injury, abdominal and iliopsoas muscles strain because the two muscles are engaged in the task of supporting the body weight while sitting. Muscle strain will lead to spasms and triggers inflammation-causing LBP (Firmanita, Rosdiana, & Indrayani, 2015). The static position of the driver causes continuous muscle contraction, so the oxygen supply to the muscles decreases. When oxygen availability is insufficient, another energy source is used in the form of carbohydrates (glucose) through an anaerobic glycolysis reaction which produces lactic acid (Hidayah, 2018). Lactic acid is a by-product of anaerobic metabolism. In drivers with a static sitting position and for a long duration, lactic acid will produce when the oxygen supply is insufficient to support energy production in muscle cells (Fitrianto & Maarif, 2020). The buildup of lactic acid in the tissues will cause fatigue in the muscles, causing feeling sore or sore after doing work (Arwinno, 2018). Risk factors for increased lactic acid levels that cause LBP in taxi drivers are age > 20 years, female gender, BMI overweight, high-frequency vibration, working duration > 8 hours in a static position, working period > 5 years, and smoking habits (Hidayah, 2018). In other study, there was an increase in lactic acid levels in the online motorcycle taxi community with the inter-variable strength of length of work and lactic acid levels of 0.028, which means sufficient (Wulandari & Wardhani, 2020). However, currently, there is no research regarding the relationship between lactic acid levels and LBP in taxi drivers.

PT. X is a business entity that concentrates its business in the transportation service industry, one of which is taxis which can be accessed via phone calls, on the spot, or online ordering applications. With the innovation of ease of access, this company can compete with other technology-based transportation companies. This company has a time system rule, namely 1. six working days and one holiday, 2. four working days and one holiday, 3. three working days and one holiday. The company gives the driver time to collect a deposit according to the agreed amount. Drivers can pick up the car at the pool at 04.00 WIB and return the car at 24.00 WIB with a deposit of Rp 275,000.00. If the driver cannot collect the deposit in that amount, the driver must accumulate the deposit the next day; if it is not reached, the driver does not get a bonus. As a result, the risk of additional working hours cannot be avoided, so drivers often need to pay more attention to the provisions for working hours, rest hours, and sitting positions.

In an initial survey conducted on March 2022, it was found that seven people experienced LBP. It could be concluded that taxi drivers were at risk of experiencing LBP, which could reduce employee productivity, loss of working time due to recovery and reduce company income. However, there is no reporting data regarding LBP which causes losses to taxi X. In addition, there is no research on the relationship between lactic acid and the LBP experience on car or taxi drivers in Indonesia, thus the authors were interested in researching lower back pain experience in taxi drivers and associated with lactic acid levels on drivers.

Research Methods

An initial survey was carried out on 7 March 2022 with interview-based method to ten taxi drivers X company. Survey data was collected and analyzed. Research was continued at the same company where it was conducted on 19-20 August 2022 by using a cross-sectional design. There were 70 drivers as source population and total sampling techniques were employed to recruit participants. Drivers who had registered into taxi company X, cooperative during the study, and 20-40 years old were randomly selected. Participants who not willing to be a respondent, participants who having a history of diseases related to the lower back (kidney disease, neurological disease, diseases or disorders or trauma to the spine), and female drivers were excluded into this study

Data were collected using a face-to-face interviewer-administered questionnaire which contained a Nordic Body Map to help respondent determine the location of pain. Low back pain experience questionnaire along with detailed information about age, years of service, and length of service was used to assess the prevalence of low back pain (Mekonnen, 2019) Lactic acid level in respondent body were measured after completing the questionnaire by took a drop of capillary blood and tested with point-of-care device (Accutrend Plus, Roche). All of the process was approved by Health Ethics Committee of STIKES Hangtuah No 560/KEPK/STIKes-HTP/VIII/ 2022. Relationship of variables were calculated using Fisher exact test. All statistical tests were considered statistically significant as $p< 0.05$.

Results and Discussions

As total 70 participants, 39 participants (55,7%) were excluded due to age > 40 years old (N=30), refusing to be respondents (N=4), refusing blood samples withdrawal (N=3), or female driver (N=2), resulting 31 participants (20-40 years old).

Table 1.
Description of Characteristics Respondents Based on Age, Years of Service, and Length of Service

Responden Characteristic	Frequency	Percentage (%)
Ages		
20-30 years	9	29.0%
30-40 years	22	71.0%
Years of Service		
< 5 years	25	80.6%
≥ 5 years	9	19.4%
Length of service/day	5	16.1%
< 8 hours	26	83.9%
≥ 8 hours		
Total	31	100.00%

Based on Table 1, it was found that the majority of respondents were aged 30-40 years, with a total of 22 respondents (71.0%). Based on years of service, it can be seen that most respondents have worked < 5 years, with a total of 25 respondents (80.6%). Based on the length of work, it can be seen that most of the respondents had a working duration of <8 hours, with a total of 26 respondents (83.9%).

Table 2.
Description of Characteristics Respondents Based on Low Back Pain

LBP	Frequency	Percentage (%)
No LBP	14	45.2
LBP	17	54.8
Total	31	100.00

Table 2 showed characteristic respondent based on pain experience where most respondents experienced LBP with total 17 respondents (54.8%).

Table 3.
Description of Characteristics Respondents Based on Lactic Acid Levels

Lactic acid	Frequency	Percentage (%)
< 2 mmol/l	20	64.5
≥ 2 mmol/l	11	35.5
Total	31	100.00

Based on table 3, it was found that 14 respondents (45.16%) had lactic acid levels <2 mmol/l, and six respondents (19.35%) experienced low back pain.

Tabel 4.
Crosstabulation Relationship between Lactic Acid Levels and LBP

Variable	LBP		Total	p value	POR (95% CI)
	No LBP	LBP			
Lactic acid < 2 mmol/l (normal)	14	6	20	0.00	2.83
Lactic acid ≥ 2 mmol/l (high)	0	11	11		
Total	14	17	31		

Based on Table 4, it was found that 14 respondents (45.16%) had lactic acid levels < 2 mmol/l without LPB experience and six respondents (19.35%) experienced LBP. Also, there were 11 respondents (35.48%) experienced LBP in ≥ 2 mmol/l lactic acid level in their bloods. Expected Chi-Square count value was less than five and a maximum of 20% of the number of cells. Thus, the alternative to the Chi-Square test for 2 x 2 tables was Fisher's test with a p-value = 0.000 (p-value <0.05). This means that there is a relationship between lactic acid levels and LBP. In addition, POR value was 2.833 (POR > 1) and it means lactic acid levels was 2.83 risk factor of LBP.

Relationship between Lactic Acid Levels and LBP

Based on Table 4, p-value of Chi-Square was 0.00 (p-value <0.05) and it means there was relationship between lactic acid levels and LBP in taxi drivers X Pekanbaru at 2022. This finding has similar result with previous work where there was a relationship between increasing levels of lactic acid and LBP, the strength of the relationship between variables was 0.028 which means the relationship between duration of work and lactic acid levels was "enough" (p-value <0.05) (Wulandari & Wardhani, 2020), This results are also in line with Hidayah (Hidayah, 2018) which showed a relationship between lactic acid levels in the blood after work and fatigue (p-value = 0.001). In Table 4, the PR value = 2,833 (PR > 1) means that lactic acid levels are a risk factor for an LBP of 2,833. This is in line with the study of Wang et al. (Wang et al., 2017) where the results of multivariate logistic regression analysis showed that the risk of reporting

LBP increased with lactic acid levels (OR 3.0, 95% CI 1.4–6.3). Factors such as age, years of service, and length of work could influence increased lactic acid levels.

As ages increase, the strengthness of muscle will be decreases, followed by decreasing of maximal oxygen volume (VO2max), sharp of vision and hearing. After the age of > 40 years, there will be a weakness in the tissues in the joint space, and the spinal discs will protrude, causing LBP (Sangaji et al., 2020). Thus, age > 40 years is included in the exclusion criteria to minimize the bias causing LBP, whether due to decreased VO2max or due to protrusion of the spine. Working period ≥ 5 years and working duration ≥ 8 hours can cause continuous static load so that blood flow is obstructed and ischemia occurs. As a result, the oxygen supply is insufficient for aerobic metabolic processes, and they switch to anaerobic metabolism. Drivers with longer working years and length of work are at risk of experiencing LBP due to lactic acid accumulation (Sari, Mogi, & Angliadi, 2015). Blood lactic acid levels that exceed the threshold value (≥ 2 mmol/l) indicate fatigue.

Based on Table 4, it was found that 14 respondents (45.16%) had lactic acid levels <2 mmol/l (not increased) who did not experience LBP, and six respondents (19.35%) experienced LBP. Respondents with lactic acid levels ≥ 2 mmol/l (increased) who did not experience LBP were 0 respondents (0%), and those who experienced LBP were 11 respondents (35.48%). It can be concluded that the majority of respondents' experience LBP in drivers, followed by increased levels of lactic acid. This is in accordance with the theory put forward by Murray (2015) that the human body will receive stimulation during its work, which causes the muscles to contract continuously so that the oxygen supply to the muscles will decrease. This condition results in a shift in the energy source for muscle activity which originally came from fatty acids when the oxygen supply is sufficient then switches to another energy source whose reform process does not require oxygen. The energy source for muscle activity when oxygen availability is insufficient is carbohydrates, namely glucose (Murray & KEnney, 2015). Glucose will be converted to pyruvic acid through the reaction of anaerobic glycolysis. Pyruvic acid will experience a reduction to lactic acid (Arwinno, 2018). Lactic acid, formed from anaerobic glycolysis, can also lower the pH so that the muscle tone turns sour. This situation can increase blood acidity if it lasts a long time. This change in pH in the muscles that become acidic will inhibit the work of glycolytic enzymes so that it will interfere with the chemical reactions that take place in cells. This will result in reduced energy produced so that muscle contractions get weaker and the muscles will experience LBP (Hidayah, 2018). Pang et al. (2019) states that increased levels of lactic acid are caused by work activities that are intensive and repetitive and are not accompanied by sufficient recovery time, which will inhibit the supply of energy from the aerobic enzyme system in muscle cells (Pang, Xie, Chen, & Hu, 2014) . This indicates that there is no balance between the rate of lactic acid production due to work activities and the rate of clearance of lactic acid obtained through recovery in the respondent's body; in other words, the rate of production of lactate is greater than the rate of clearance of lactic acid (Hidayah, 2018).

Nanang et al. (2018) stated that the resting lactic acid threshold is around 1.8 mmol/l, and blood lactic acid levels are above the average normal level (greater than two mmol/l) (Nanang, Fuad, Didik, Topo, & Panuwun, 2018). Respondents with normal lactic acid levels and who did not experience LBP totaled six respondents. This happened because the respondents had taken a long rest (>1 hour), did stretching, or had taken painkillers before so that LBP complaints were gone and blood lactic acid levels were slow has decreased. Respondents with normal lactic acid levels but experiencing LBP indicate that lactic acid recovery occurs by resting. This follows the theory put forward by Mota et al. (2017), where there is a balance between lactate production and lactate clearance under normal conditions. The rate of lactic acid production as a result of the respondent's work activities is balanced with the rate of cleaning lactic acid carried out by the respondent's body (Mota et al., 2017). As is well known, the removal of lactic acid can occur with both active and passive recovery efforts by respondents (Wulandari & Wardhani, 2020). The average lactic acid level of 31 respondents in this study was 1.70 mmol/l. Efforts made by drivers to reduce LBP complaints are by sleeping; no drivers specifically consume pain relievers or herbs. The company's daily target policy, non-optimal rest, and lack of physical activity cause muscle relaxation, and lactic acid recovery is not optimal.

Based on biochemical changes, lactic acid recovery occurs for 60 minutes, and the peak of lactic acid accumulation occurs 5 minutes after physical activity (Mallapiang, As'ad, Russeng, Nurdin, & Bahar, 2015). Recovery of blood lactic acid levels can take place actively or passively. This will affect the mechanism for releasing lactate from the muscles to the blood, increasing blood flow and lactate uptake by the liver, heart, and skeletal muscles. The active recovery stage occurs when the cessation of activity or exercise occurs slowly by reducing both the quantity and quality of activity until the metabolite results are at normal levels. Recovery is said to be passive if the activity is stopped immediately without going through the stages of reducing the quality and quantity of the activity. One of the active ways to restore blood lactic acid levels that drivers can do is by stretching muscles or sitting for a while between work hours, while passive recovery of blood lactic acid levels can be made by respondents by sleeping and leaving work (Hidayah, 2018). Stretching can help prevent recovery from wrong muscle attitudes, tense muscles due to sitting for a long time, and blood circulation, which inhibits tension and pressure (Kellmann, Pelka, & Beckmann, 2017).

Recovery by doing stretching movements that begin with dynamic movements and then static can accelerate the reduction of lactic acid levels in the blood; this is due to increased metabolism of the blood circulation system through oxidation and gluconeo-genesis, thus helping to increase the transport and delivery of oxygen through hemoglobin to active muscle cells. It will ultimately affect the resynthesis of lactic acid. Activation of the venous pump and lymph pump occurs in dynamic muscle contractions. When the muscle contracts, the veins and lymph vessels in and around the muscle are pinched so that blood and lymph are squeezed out of the vessels, then during relaxation, the vessels are filled again by blood and lymph derived from active muscle tissue, not blood and lymph that were previously squeezed out. With the activation of the muscle pump system, there is an acceleration of tissue circulation within the active muscle. This circulation acceleration helps the homeostatic maintenance mechanism and accelerates recovery in sports activities due to the acceleration of the supply of all substances needed by the tissues and the acceleration of the removal of lactic acid from the blood (Griwijoyo & Sidik, 2013).

One of the main elements in increasing lactate recovery in the blood is oxygen. The more lactic acid and the more oxygen is needed (Zebrowska, Trybulski, Roczniok, & Marcol, 2019). Regular physical exercise will increase VO2max normal oxygen consumption in the bloodstream, thereby accelerating lactic acid recovery (Strasser & Burtscher, 2018). VO2max is the maximum volume of oxygen used by a person, and it is measured in millimeters per kilogram of body weight per minute (ml/kg/minute). Respondents with high VO2max showed better recovery ability than those with low VO2max because more oxygen enters the body, so blood circulation is better, resulting in lactic acid being immediately oxidized to produce energy through aerobic metabolism (Monica Septinia, Ahmad, & Olivia, 2022). Lactate is converted to pyruvic acid, and then this pyruvic acid enters the mitochondria to undergo a series of oxidation processes known as Krebs' cycle and an electron transport system to produce energy (Rabinowitz & Enerbäck, 2020). Condition such as acetaminophen users (Iza & Pratama, 2020), short bowel syndrome (SBS) (Kowlgi & Chhabra, 2015), alcohol addiction (Yang, Chan, Tseng, & Weng, 2016), and heart disease (Lazzeri, Valente, Chiostri, & Gensini, 2015). However, in this study, respondents with the above conditions were excluded.

Conclusions

Based on the results and discussion of the relationship between lactic acid levels and low back pain in X taxi drivers Pekanbaru, it can be concluded that there was a relationship between lactic acid levels and the incidence of low back pain with a p-value = 0.000 ($p < 0.05$). Lactic acid levels are a risk factor for LBP at PR = 2,833 (PR > 1).

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