Ergonomics Risk Analysis Of Public Transportation Drivers
(Study Case: Public Transportation Drivers In Makassar City)

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ABSTRACT

Complaints on occupational diseases experienced by many workers, one of the causes of this complaint is the lack of good work position of a worker, an unfavorable work position and carried out for a long period of time will have a painful effect on the muscles. Driver is a job that requires a person to sit for a long time in the same position. this causes some workers to feel pain at some point on their body, such as the back and legs. driver's work area which is very limited to do the movement also makes the driver unable to stretch when in the car. This research will identify the level of ergonomic risk from the position of the driver of public transport in the city of Makassar using Nordic Body Map dan RULA method. This study involved 21 randomly selected drivers. The identification results using the Nordic body map method showed that the driver feels pain in some limbs such as the back, waist, hips buttock and legs. while the identification results using the RULA indicate that the current driving position has a very high ergonomic risk and must be change as soon as possible to avoid further injury in the future.

1. INTRODUCTION

Complaints about workers' body postures are very common, this is due to the lack of knowledge of workers about the dangers of working in a work environment that is not ergonomic. Musculoskeletal disorder (MSDs) or musculoskeletal disorders are disorders that cause symptoms of pain in various body locations such as the neck, shoulders, wrists, hips, knees and heels (Cho et al, 2016). WHO (World Health Organization) states that this disorder is caused by several risk factors such as individual factors, employment factors and psychosocial factors (Cho et al, 2016). The job factor in question is awkward posture, static and repetitive movements, temperature and vibration. Psychosocial factors have a monotonous work performance, little social interaction, lack of work control. Individual factors are more to gender, age, level of education, lifestyle, habit of exercise and tenure (Oha et al, 2014, in Dian, 2017) The employment sector in the transportation sector is one of the occupational sectors that are very at risk of developing musculoskeletal disorders, workers in the transportation sector such as drivers of public transport can be exposed to various risk factors that can disrupt health. Health problems that are usually experienced by public transportation drivers such as fatigue, tension, to insomnia, this results in disruption of the driver's driving performance (Lalit et al, 2015, in Dian, 2017). The condition and situation of the road that is traversed by public transportation is also one of the factors that can add to the severe disruption experienced by public transport drivers.

Research on the risks of ergonomics has often been done (Palupi, et al. 2017). Identifying the risks of ergonomics of workers who make sanitary products. the method used is Nordic body map and REBA. Rinawati, et al. 2016. Identifies the risk of work posture on workers in the selection and weighing section of linen using the REBA method. This study uses public transport drivers as research subjects using the Nordic Body Map method and RULA method.

2. METHODS

This research was conducted on 21 public transport drivers in the city of Makassar who were chosen randomly. The driver route 05 which passes the Malengkeri Terminal Line – Cendrawasi St – Hasanuddin University is chosen because it has the longest route, 24 km. Total population is 146 public transportations, with calculations to determine the number of samples using an 80% confidence level, then obtained as many as 21 drivers as samples in this study.

Problem solving for this study uses 2 methods, Nordic Body Map and Rapid Upper Limb Assessment. The first method is the Nordic body map that is used to identify the location of the driver's body that feels
pain while driving. After identifying the location of a painful body part, identification of the worker's posture will be carried out using the RULA (rapid upper limb assessment) method to find out whether the driver's position or posture is correct or not. The use of the RULA method is carried out in the first two stages: the first is taking photos of the driver while driving and the second is identifying the driver's body posture by determining the angle formed by the driver while driving which is assessed based on the RULA worksheet. RULA method divides the assessment into 2 groups. the first group is an assessment of the upper arm, forearm, wrist, and wrist twist. The second group is the assessment of the neck, trunk, and legs. the assessment on the RULA method also pays attention to the burden that is raised and also activities that cause stiff muscles because they have to be done repeatedly and for a long time.

1. **Nordic Body Map**

Nordic body map is a simple questionnaire method that can be used to identify the location of pain in the human body when working like a Musculoskeletal disorder. This method can measure pain in the worker's muscles and know the pain of discomfort in the worker's body (Dian, 2017). The results of this NBM are the perceptions of the workers identified. There is a standard format in the NBM questionnaire, containing 28 body parts from neck to foot.

2. **RULA (Rapid Upper Limb Assessment)**

RULA is a method that can be used to categorize and assess the risk of worker posture (David, 2005 in Dian 2017). RULA can assess the risk of upper body posture both dynamic, static and unstable. RULA method can be used to assess the design of work stations.

3. **RESULT AND DISCUSSION**

This research was carried out in two stages, the first stage used the Nordic body map method to identify parts of the body that were felt sick while driving, the second stage is to identify the driver's work posture using the RULA method. in table 1 can be seen the results of data collection using an NBM questionnaire from 21 public transport drivers.

| Table 1. The results of data processing using Nordic Body Map |
|-------------------------------------------------------------|
| Parts of body       | 1 | 2 | 3 | 4 |
|---------------------------------|---|---|---|---|
| 0  | Neck | 6 | 14 | 1 | 21 |
| 1  | Nape of neck | 6 | 12 | 3 | 21 |
| 2  | Left shoulder | 15 | 5 | 1 | 21 |
| 3  | Right shoulder | 16 | 4 | 1 | 21 |
| 4  | Left upper arm | 17 | 4 | 21 |
| 5  | Back | 9 | 12 | 21 |
| 6  | Right upper arm | 15 | 5 | 1 | 21 |
| 7  | Waist | 5 | 13 | 3 | 21 |
| 8  | Hip | 6 | 12 | 3 | 21 |
| 9  | Butt | 2 | 13 | 6 | 21 |
| 10 | Left elbow | 20 | 1 | 21 |
| 11 | Right Elbow | 20 | 1 | 21 |
based on data collected from 21 public transport drivers in Makassar using the Nordic body map method, the driver's body parts that are felt to be sick while driving are neck, nape of neck, back, waist, hips, buttocks, left calf, right calf, left ankle, right ankle and left foot

| No | parts of body | Cause |
|----|---------------|-------|
| 1  | Neck          | sitting position that is too tense due to uncomfortable and worn car seats, and also the sitting position carried out for a long time without rest and body stretching |
| 2  | Nape of neck  | sitting position that is too tense due to uncomfortable and worn car seats, and also the sitting position carried out for a long time without rest and body stretching |
| 3  | Back          | sitting position that does not support your back properly due to a bad sitting position |
| 4  | Waist         | sitting for a very long time |
| 5  | Hips          | sitting for a very long time |
| 6  | Butt          | sitting for a long time and an uncomfortable seat because of worn out car seats |
| 7  | Left calf     | caused by stepping on the clutch pedal continuously especially when passing a jammed road, which makes the calf feel tense |
| 8  | Right calf    | caused by stepping on the gas pedal continuously especially when passing a traffic jam, which makes the calf feel tense |
| 9  | Left ankle    | caused by stepping on the clutch pedal continuously especially when passing a jammed road, which makes the calf feel tense |
| 10 | Right ankle   | caused by stepping on the gas pedal continuously especially when passing a traffic jam, which makes the calf feel tense |
| 11 | Left foot     | caused by stepping on the clutch pedal continuously especially when passing a jammed road, which makes the calf feel tense |
After identifying the parts of the body that are usually felt pain, identification of the work position risk using the RULA method will be carried out.

Figure 1. driving position

Table 3. Table A RULA

| Upper Arm | Lower Arm | Wrist | Twists | Wrist | Twists | Wrist | Twists |
|-----------|-----------|-------|--------|-------|--------|-------|--------|
| 1         | 1         | 1     | 2      | 2     | 2      | 2     | 2      |
| 2         | 2         | 2     | 3      | 3     | 3      | 3     | 3      |
| 3         | 3         | 3     | 4      | 4     | 4      | 4     | 4      |
| 4         | 4         | 4     | 5      | 5     | 5      | 5     | 5      |
| 5         | 5         | 5     | 6      | 6     | 6      | 6     | 6      |
| 6         | 6         | 6     | 7      | 7     | 7      | 7     | 7      |

Table 4. Table B RULA
### Table 5. Table C RULA

![Table C: Neck, trunk and leg score](image)

### Table 6. RULA Score of 21 respondents

| No | Name | Photo | Rula score | No | Name | Photo | Rula score |
|----|------|-------|------------|----|------|-------|------------|
| 1  | Amil | ![Amil](image) | 7          | 9  | Asman| ![Asman](image) | 7           | 17 | Edo | ![Edo](image) | 7 |
| 2  | Dg Nai | ![Dg Nai](image) | 7          | 10 | Aco  | ![Aco](image) | 7           | 18 | Ansar | ![Ansar](image) | 7 |
| 3  | Ardi | ![Ardi](image) | 7          | 11 | Sapri | ![Sapri](image) | 7           | 20 | Dg Lao | ![Dg Lao](image) | 7 |
| 4  | Pariang | ![Pariang](image) | 7          | 12 | Asqar | ![Asqar](image) | 7           | 21 | Syahrul | ![Syahrul](image) | 7 |
| 5  | Yudi | ![Yudi](image) | 7          | 13 | Dg Limpo | ![Dg Limpo](image) | 7 |
Table 6 shows the results of calculating the work posture of 21 public transport drivers using the RULA method. From the results of the identification, it is known that the driver's posture gets a total value of 7, which means that it must be investigated immediately and made changes or improvements to the driving position. Incorrect driving position and long driving duration without stretching the body every hour will cause muscle injury.

| RULA Score | Risk Level          | Corrective Action     |
|------------|---------------------|-----------------------|
| 1 or 2     | Acceptable posture  |                       |
| 3 or 4     | Further investigation| Change may be needed  |
| 5 or 6     | Further investigation| Change soon           |
| 7          | Investigate         | Implement change      |

The driver's work posture that causes high risk of ergonomics is:

1. Sitting position, sitting position is not good and lasts a long time with will cause pain in the back, waist, hips and buttocks.
2. The condition of the car seat is not comfortable, most of these public transport car seats are outdated and not worthy of use also most public transport seats have been modified and the car seats are not ergonomically used when driving for a long time
3. Stepping on the pedal alternately for a long time, road conditions in Makassar are often jammed causing public transport drivers who are still using manual transmission to feel the pain in the calf and legs because they hold the car pedal
4. Lack of rest of the driver, most public transport drivers will operate their cars more than 8 hours a day without resting every hour to stretch
5. The condition of the car is old, the steering wheel of the car that has a heavy power steering makes a rather heavy burden if the car wants to turn or turn around.
6. Many modified public transports do not meet the standards, for example a smaller steering wheel causes very limited hand movements.

The results of the analysis of the Nordic body map method of 21 public transport drivers were obtained through the interview process by filling out the NBM questionnaire. The identification results indicate that the driver has not felt the unbearable pain in his limbs, but there are some drivers who complain of pain in some parts of the body such as the neck, nape, back, waist, hips, buttocks, left thighs, right thighs, left knee, right knee, right ankle, left ankle, and left leg. This is caused by the wrong driving position and long driving duration without any rest to stretch. Road conditions that are often jammed in traffic and hot weather also affect the driver's fatigue conditions, causing muscle tension and body fatigue. Identification using rapid upper limb assessment method shows that all drivers get a score of 7, meaning that the driver's position needs to be investigated further and immediate repairs. The position of the driver is strongly influenced by the existing facilities in public transport cars, generally public transportation is an old car that has been very outdated facilities in it such as car seats that have been changed a lot for
reasons of modifying the car and not paying attention to the ergonomic aspects of the seat. Modification is not only done for car seats, most public transportation in the city of Makassar changes the default steering wheel of the car with a very small steering wheel which causes the arm's position to cross because of the very small steering area. The results of interviews with public transport drivers found that the average driver will be on the road for 10-15 hours a day to deliver passengers so that driving conditions will last for a long time without sufficient rest or stretch the body so that the muscles are not stiff due to the sitting position. so long. The congested road conditions of Makassar also increase muscle load while driving when road conditions are jammed. Hot weather in the city of Makassar and the absence of cooling/air conditioning on public transport also add to the factor of fatigue when driving.

4. CONCLUSION
Driving position of a public transport driver has a very high risk of ergonomics, this is because the chair is not ergonomic because it is outdated and not suitable for use. The absence of a rest period that inevitably causes many drivers to drive their cars for hours without a break to stretch. Results of this identification, it is expected that there will be an improvement in the driving position and also require the driver to take hourly breaks to stretch.

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