

## ORIGINAL ARTICLE

## ACCESSING DRIVING POSTURE AMONG ELDERLY TAXI DRIVERS IN MALAYSIAN USING RULA AND QEC APPROACH

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## ABSTRACT

An elderly community may continue to serve their services to other jobs after retirement particularly in light works in accordance to their ability which can support the household income in such a challenging world. One of the professions that they could alternatively get involved is by being a taxi driver. Hence, the characteristic of elderly taxi driver is crucial to understand, primarily due to the ageing process which makes them more vulnerable towards injury. Sitting which is the working posture of a taxi driver should be properly done to avoid injuries among the elders. Improper seating posture is potentially unhealthy and considered as one of the major contributing factors for several musculoskeletal disorders (MSD) such as pain in the lower back part and shoulder. Due to increased exposures to seating posture inside the car, the proper sitting adjustment has become an important issue that demands adequate ergonomic interventions. A cross-sectional study was conducted with elderly taxi drivers using a self-administered questionnaire. It included questions on social-demographic data, Rapid Upper Limb Assessment (RULA) and Quick Exposure Check (QEC). Purposive method sampling is used according to these inclusive criteria; age 60 years old and above, self-driving taxi more than 1 year, no disabilities and registered with Ministry of Transport (MOT). Total of 443 respondents participated in the study. SPSS software version 20.0 to analyze data and RULA and QEC form was used. More than half elderly taxi driver used budget car (57.6%) type of taxi and most of elderly taxi drivers were smoking (66.0%). More than half respondents (70.0%) having felt back pain for the past 12 months and 75.4% feeling back pain the last seven days. 94.8% elderly taxi drivers complained of feeling low back pain. QEC showed higher score - neck (20.8%) and back body part (6.5%) and other factors at high score - driving (86.4%) and vibration (45.6%). RULA analysis body score at value score 7 (23.5%) - required immediate improvement and value score 5/6 (61.9%) - required investigation and needed to improve soon. Inappropriate seating posture among elderly taxi drivers may cause discomfort towards developing MSD. The implication of low awareness on ergonomics education could reflect quality lifestyle and health among elderly taxi drivers in Malaysia.

**Keywords:** RULA, QEC, elderly, taxi driver, awkward posture, ergonomics

## INTRODUCTION

The characteristic of elderly people may differ from other ages in terms of physiological, sensory, perceptual, motor and cognitive abilities that may impact on how elderly interact with task and behaviour<sup>1</sup>. Past research indicated that approximately one-third of pensioners were vulnerable to poor retirement and outcomes in term of life satisfactions and well-being<sup>2,3</sup>. Therefore, the elderly community may continue to serve their services after retirement by performing manageable works in accordance to their ability or do part time jobs to support family financial towards sustainable life in this challenging world. Most of them prefer to be taxi drivers to replace previous jobs after retirement. This consider as light job that is easy to handle, less energy, low cost, no specific requirement (standard license), no specific regulation and also it is an advantage if they have experience in driving on commercial or private car. According to data in the year 2013 from Land Public Transport Commission (SPAD), there are approximately

64,547 registered taxi drivers in Malaysia. These numbers are also representing taxi drivers dominantly under elderly category.

A lot of factors make elderly taxi drivers distinct from other professions in term of exposure values when working with MSD-related jobs. Firstly, it is the time factor; the previous study stated that most of the taxi drivers spent longer time in driving compared to other driving profession - professional driver; lorry driver, bus driver, train driver<sup>4</sup>. Several researchers<sup>5-8</sup> found that other occupational factors such as whole-body vibration, long working hours, limited driving space, total mileage, long distance driving, monotonous driving, time employed as a taxi driver, job dissatisfaction, and job stress may contribute injuries on low back pain and also related to MSD generally. Taxi drivers have a high risk of damaging the human biological clock rhythm and a risk of fatigue, depression, tension, insomnia and other diseases<sup>9</sup>.

Car seat design and seat arrangement plays important role to human body specifically on health. Numerous of complaint obtained from past researchers among taxi drivers related to MSD especially on low back pain<sup>8, 10, 11, 12, 13</sup>. Improper seating posture is potentially unhealthy and considered as one of the major contributing factors for several MSD such as pain in the lower back part<sup>14</sup>, neck<sup>15</sup> and shoulder<sup>16</sup>. Due to increased exposures to seated posture in the car, the proper sitting adjustment has become an important issue that demands adequate ergonomic interventions<sup>17</sup>. According to Andreono et al. (2002), driver's seat comfort in a car has distinctive comfort value compared to other types of seats. The drivers can show naturally discomfort if his body will feel pressured, burdened and emotionally destructed. Research conducted<sup>19</sup> revealed that adjustability of driver's seat was the most cited parameter to increase the safety and comfort level. In worst situation, elderly drivers will feel pain and injury at upper torso body part especially lower back body part.

Drivers' seats such as seat pans, seat inclination, sitting without lumbar support and awkward body posture bending during driving were reported in MSD on lower back pain. One of the most important contributions that ergonomics can provide to the automobile design process is information of the physical size of driver, and his/her preferred posture<sup>20</sup>. A comfortable and safe driver's seat plays a very important role in car design and fabrication. As mentioned from past research<sup>21</sup>, drivers' comfort was as important as the functional and aesthetic design of automobiles since users (elderly) were more concerned about safety and comfortable driving. The application of ergonomics in ensuring comfortable and safe posture for elderly taxi drivers to ensure better lifestyle and minimize the health problem on work-related MSD. Recently, authors have not found any study directly assessed the association between awareness of ergonomics factors and MSD on seating posture among elderly taxi drivers in Peninsular Malaysia. This paper aimed to do assessment on seating posture using *Rapid Upper Limb Assessment* (RULA) and *Quick Exposure Check* (QEC) method among elderly taxi drivers in Peninsular Malaysia (Figure 1- showed current seating posture of the elderly taxi driver).



Figure 1: Driving posture overview

## METHODS

The design of this study was a cross-sectional survey using a questionnaire to investigate characteristics of driving background and seating posture assessment using RULA and QEC approach among elderly taxi drivers in Peninsular Malaysia. The study was conducted around rural and urban area in four regions of peninsular Malaysia. A purposive sampling was chosen, and 443 respondents participated in the study. Criteria sample has been chosen; age above 60 years old, at least 1-year taxi driving experience, registered with Land Public Transport Commission (LPTC), who had a history of major surgery or history of neurological problems were excluded. However, taxi drivers that have attended any courses or training related with occupational health and take it as a part time job with less than 4 hours driving per-day were excluded. Types of taxi services involved were the 'budget car' and 'hired' car only. Every respondent in peninsular Malaysia aged 60 years above driving 'budget car' and 'hired' car with standard seat design. No modification on the seat is involved. Each survey took approximately 10 -15 minutes to complete.

The posture of each of elderly taxi driver performing their task was recorded using a video recorder. This process is intended to capture the posture of the driving activities. Each video focuses on the most extreme position on seating posture of the elderly taxi driver's position. Video footage of 15 minutes for each elderly taxi driver was recorded during the task. The purpose of recording is to analyze body posture in the extreme position through Rapid Upper limb Assessment (RULA) (Figure 2) observation and Table 1 showed classification of RULA score.

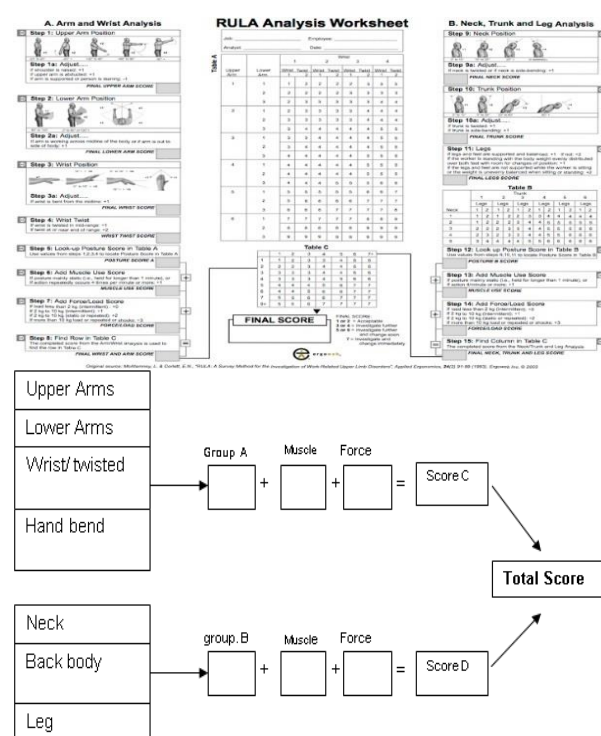


Figure 2: RULA form and RULA calculation.

Table 1: Classification of RULA score

| Score | Description   |
|-------|---|
| 1-2   | Indicates that the posture is acceptable if it is not maintained or repeated for long periods of time |
| 3-4   | Indicates that further investigation is needed, and changes may be required                           |
| 5-6   | Indicates that investigation and changes are required soon  |
| 7     | Indicates that investigation and changes are required immediately                                     |

Meanwhile, for QEC method involved between observer and practitioners (Figure 3). QEC allowed physical work activities to be assessed in collaboration with the worker. It has been designed to be quick, easy to use and does not require extensive training. QEC assesses the exposure of four body areas at greatest risk to the most important risk factors for work related musculoskeletal disorders (Figure 4). The QEC assessment encouraged consideration of changes to workstation, tools, equipment and working methods to eliminate or at least minimize level of exposure.

Worker's name \_\_\_\_\_ Date \_\_\_\_\_

**Observer's Assessment**

**Back**

A When performing the task, is the back (select worst case situation)

A1 ☐ Almost neutral?

A2 ☐ Moderately flexed or twisted or side bent?

A3 ☐ Excessively flexed or twisted or side bent?

B Select **ONLY ONE** of the two following task options:

**EITHER**

For seated or standing stationary tasks, does the back remain in a static position most of the time?

B1 ☐ No

B2 ☐ Yes

**OR**

For lifting, pushing/pulling and carrying tasks (i.e. moving a load), is the movement of the back

B3 ☐ Infrequent (around 3 times per minute or less)?

B4 ☐ Frequent (around 8 times per minute)?

B5 ☐ Very frequent (around 12 times per minute or more)?

**Shoulder/Arm**

C When the task is performed, are the hands (select worst case situation)

C1 ☐ At or below waist height?

C2 ☐ At about chest height?

C3 ☐ At or above shoulder height?

D Is the shoulder/arm movement

D1 ☐ Infrequent (some intermittent movement)?

D2 ☐ Frequent (regular movement with some pauses)?

D3 ☐ Very frequent (almost continuous movement)?

**Wrist/Hand**

E Is the task performed with (select worst case situation)

E1 ☐ An almost straight wrist?

E2 ☐ A deviated or bent wrist?

F Are similar motion patterns repeated

F1 ☐ 10 times per minute or less?

F2 ☐ 11 to 20 times per minute?

F3 ☐ More than 20 times per minute?

**Neck**

G When performing the task, is the head/neck bent or twisted?

G1 ☐ No

G2 ☐ Yes, occasionally

G3 ☐ Yes, continuously

**Worker's Assessment**

**Workers**

H Is the maximum weight handled MANUALLY BY YOU in this task?

H1 ☐ Light (5 kg or less)

H2 ☐ Moderate (6 to 10 kg)

H3 ☐ Heavy (11 to 20 kg)

H4 ☐ Very heavy (more than 20 kg)

J On average, how much time do you spend per day on this task?

J1 ☐ Less than 2 hours

J2 ☐ 2 to 4 hours

J3 ☐ More than 4 hours

K When performing this task, is the maximum force level exerted by one hand?

K1 ☐ Low (e.g. less than 1 kg)

K2 ☐ Medium (e.g. 1 to 4 kg)

K3 ☐ High (e.g. more than 4 kg)

L Is the visual demand of this task

L1 ☐ Low (almost no need to view fine details)?

L2 ☐ High (need to view some fine details)?

*\*If High, please give details in the box below:*

M At work do you drive a vehicle for

M1 ☐ Less than one hour per day or fewer?

M2 ☐ Between 1 and 4 hours per day?

M3 ☐ More than 4 hours per day?

N At work do you use vibrating tools for

N1 ☐ Less than one hour per day or fewer?

N2 ☐ Between 1 and 4 hours per day?

N3 ☐ More than 4 hours per day?

P Do you have difficulty keeping up with this work?

P1 ☐ Never

P2 ☐ Sometimes

P3 ☐ Often

*\*If High, please give details in the box below:*

Q In general, how do you find this job

Q1 ☐ Not at all stressful?

Q2 ☐ Mildly stressful?

Q3 ☐ Moderately stressful?

Q4 ☐ Very stressful?

*\*If Moderately or Very, please give details in the box below:*

Exposure Scores Worker's name \_\_\_\_\_ Date \_\_\_\_\_

**Back**

Back Posture (A) & Weight (H)

A1 A2 A3

H1 H2 H3 H4

Score 1

Back Posture (A) & Duration (J)

A1 A2 A3

J1 J2 J3

Score 2

Duration (J) & Weight (H)

J1 J2 J3

H1 H2 H3 H4

Score 3

How do you find this job (Q)

Q1 Q2 Q3 Q4

Score 4

Static Posture (B) & Duration (J)

B1 B2 B3 B4 B5

J1 J2 J3

Score 5

Frequency (B) & Weight (H)

B3 B4 B5

H1 H2 H3 H4

Score 6

Frequency (B) & Duration (J)

B3 B4 B5

J1 J2 J3

Score 7

Total score for Back

Sum of Scores 1 to 7

**Shoulder/Arm**

Height (C) & Weight (H)

C1 C2 C3

H1 H2 H3 H4

Score 1

Height (C) & Duration (J)

C1 C2 C3

J1 J2 J3

Score 2

Duration (J) & Weight (H)

J1 J2 J3

H1 H2 H3 H4

Score 3

Frequency (C) & Weight (H)

C1 C2 C3

H1 H2 H3 H4

Score 4

Frequency (C) & Duration (J)

C1 C2 C3

J1 J2 J3

Score 5

Total score for Shoulder/Arm

Sum of Scores 1 to 5

**Wrist/Hand**

Repeated Motion (F) & Force (K)

F1 F2 F3

K1 K2 K3

Score 1

Repeated Motion (F) & Duration (J)

F1 F2 F3

J1 J2 J3

Score 2

Duration (J) & Force (K)

J1 J2 J3

K1 K2 K3

Score 3

Wrist Posture (E) & Force (K)

E1 E2

K1 K2 K3

Score 4

Wrist Posture (E) & Duration (J)

E1 E2

J1 J2 J3

Score 5

Total score for Wrist/Hand

Sum of Scores 1 to 5

**Neck**

Neck Posture (G) & Duration (J)

G1 G2 G3

J1 J2 J3

Score 1

Visual Demand (L) & Duration (J)

L1 L2

J1 J2 J3

Score 2

Total score for Neck

Sum of Scores 1 to 2

**Driving**

M1 M2 M3

Score 1

**Vibration**

N1 N2 N3

Score 1

**Work pace**

P1 P2 P3

Score 1

**Stress**

Q1 Q2 Q3 Q4

Score 1

Figure 3: QEC form and calculation

| Important risk factors  |   |
|---|---|
| Back  | Wrist/hand  |
| <ul style="list-style-type: none"> <li>load weight</li> <li>duration</li> <li>frequency of movement</li> <li>posture</li> </ul>     | <ul style="list-style-type: none"> <li>force</li> <li>duration</li> <li>frequency of movement</li> <li>posture</li> </ul> |
| Shoulder/arm  | Neck  |
| <ul style="list-style-type: none"> <li>load weight</li> <li>duration</li> <li>task height</li> <li>frequency of movement</li> </ul> | <ul style="list-style-type: none"> <li>duration</li> <li>posture</li> <li>visual demand</li> </ul>                        |

| Score         | Exposure level |          |       |           |
|---------------|----------------|----------|-------|-----------|
|               | Low            | Moderate | High  | Very High |
| Back (static) | 8-15           | 16-22    | 23-29 | 29-40     |
| Back (moving) | 10-20          | 21-30    | 31-40 | 41-56     |
| Shoulder/arm  | 10-20          | 21-30    | 31-40 | 41-56     |
| Wrist/hand    | 10-20          | 21-30    | 31-40 | 41-46     |
| Neck          | 4-6            | 8-10     | 12-14 | 16-18     |

| Score     | Exposure level |          |      |           |
|-----------|----------------|----------|------|-----------|
|           | Low            | Moderate | High | Very High |
| Driving   | 1              | 4        | 9    | -         |
| Vibration | 1              | 4        | 9    | -         |
| Work pace | 1              | 4        | 9    | -         |
| Stress    | 1              | 4        | 9    | 16        |

Figure 4: QEC body segment and QEC score

## RESULTS

Majority elderly taxi drivers (57.6%) used 'budget' type of taxi. Almost all respondents were male (98.9%). Mean ( $\pm$ SD) age of the respondents was  $66.0 \pm 3.8$  years and age ranged from 60 to 83 years old. Most elderly taxi drivers were in the age of more than 66 years old (50.3%). BMI was overweight (48.5%) and majority was Malay (68.6%) second was India (17.8%), secondary school (59.1%) for education level. The majority of respondents (66.4%) worked under company. Mean income per-month RM  $2000 \pm 796.8$  from RM200 to RM6000. The smoking status answered smoker (yes) more than half (66.1%). The detailed background of elderly taxi drivers is shown in Table 2.

**Table 2: Background elderly taxi drivers.**

| Factors                      | N (%)     | Mean $\pm$ (SD)  | Min | Max  |
|------------------------------|-----------|------------------|-----|------|
| <b>Category taxi</b>         |           |                  |     |      |
| Hired car                    | 188(42.4) |                  |     |      |
| Budget                       | 255(57.6) |                  |     |      |
| <b>Gender</b>                |           |                  |     |      |
| Male                         | 438(98.9) |                  |     |      |
| female                       | 5 (1.1)   |                  |     |      |
| <b>Age</b>                   |           |                  |     |      |
|                              |           | 66 $\pm$ 3.8     | 60  | 83   |
| 60>65                        | 220(49.7) |                  |     |      |
| >66                          | 223(50.3) |                  |     |      |
| <b>BMI</b>                   |           |                  |     |      |
| Underweight                  | 6 (1.4)   |                  |     |      |
| Normal                       | 137(30.9) |                  |     |      |
| Overweight                   | 215(48.5) |                  |     |      |
| Obese                        | 85(19.2)  |                  |     |      |
| <b>Ethnicity</b>             |           |                  |     |      |
| Malay                        | 304(68.6) |                  |     |      |
| India                        | 79(17.8)  |                  |     |      |
| Chinese                      | 59(13.3)  |                  |     |      |
| <b>Education</b>             |           |                  |     |      |
| None                         | 18(4.1)   |                  |     |      |
| Primary school               | 161(36.3) |                  |     |      |
| Secondary school             | 262(59.1) |                  |     |      |
| University                   | 2(0.2)    |                  |     |      |
| <b>Jobs sectors</b>          |           |                  |     |      |
| Company                      | 294(66.4) |                  |     |      |
| Self - employed              | 149(33.6) |                  |     |      |
| <b>Income per-month (RM)</b> |           |                  |     |      |
|                              |           | 2000 $\pm$ 796.8 | 200 | 6000 |
| <b>Smoking status</b>        |           |                  |     |      |
| Yes/frequent                 | 293(66.1) |                  |     |      |
| No/never                     | 150(33.9) |                  |     |      |

N=443

**Abbreviations and Notes:** SD = Standard deviation, Min indicates Minimum, Max indicates Maximum.

## Result of Postural Analysis

### RULA

Table 3 showed that a total percentage of 23.5% elderly taxi drivers had the score of 7 and the action level is 4 indicating investigation and changes are required immediately. For a total score of 5 or 6, 61.9% harvesters were classified under action 3 which described that investigation and changes were required immediately. Yet there were only 14.7% elderly taxi drivers in the posture in which the score was 3 or 4 at level of action 2 which described the needs of further investigation and changes that may be required. None of them indicated satisfactory posture.

**Table 3: RULA posture analysis**

| Value Score | Level of action | N    | Percentage (%) |
|-------------|-----------------|------|----------------|
| 1/2         | 1               | 0    | 0              |
| 3/4         | 2               | 65.0 | 14.7           |
| 5/6         | 3               | 274  | 61.9           |
| 7           | 4               | 104  | 23.5           |

N = 443

### QEC

Table 4 showed that the QEC experienced from elderly taxi drivers at body parts segments and other factors that had been determined. For the higher-level exposure scores for body parts segments was on the neck parts (20.8%) at score between 16-18 and followed by the back-body part (6.5%) on the static movement at the score 29-40. The neck part also showed higher value percentage of 76.5% on high-level exposure score and followed by shoulder part (55.0%) and back body parts on static movement (49.9%) in the same exposure level. However, in the medium exposure level score showed that wrist was the highest (55.5%), followed by back body part (43.6%) on static mode and shoulder (41.8%). Meanwhile, other factors assessed in QEC such as driving, vibration, work pace and stress that showed high scores on exposure level were driving activity (86.4%) and vibration (45.6%). More than 65.0% elderly taxi drivers agreed that exposure level score was moderate for factors of work pace. In the same group, the stress factor (42.7%) was the second higher exposure level and followed by vibration factor (16.9%).



**Table 4: QEC exposure analysis**

| Action level score (body parts)    | Factors      |                |           |                |           |                |        |                |
|------------------------------------|--------------|----------------|-----------|----------------|-----------|----------------|--------|----------------|
|                                    | back(static) |                | Shoulder  |                | Wrist     |                | Neck   |                |
|                                    | N            | Percentage (%) | N         | Percentage (%) | N         | Percentage (%) | N      | Percentage (%) |
| Low                                | 0.0          | 8-15<br>0.0    | 0.0       | 10-20<br>0.0   | 1.0       | 10-20<br>0.2   | 0.0    | 4-6<br>0.0     |
| Moderate                           | 193.0        | 16-22<br>43.6  | 185.0     | 21-30<br>41.8  | 246.0     | 21-30<br>55.5  | 12.0   | 8-10<br>2.7    |
| High                               | 221.0        | 23-29<br>49.9  | 244.0     | 31-40<br>55.1  | 183.0     | 31-40<br>41.3  | 339.0  | 12-14<br>76.5  |
| Very high                          | 29.0         | 29-40<br>6.5   | 14.0      | 41-56<br>3.2   | 13.0      | 41-56<br>2.9   | 92.0   | 16-18<br>20.8  |
| Action level score (Other factors) | Factors      |                |           |                |           |                |        |                |
|                                    | Driving      |                | Vibration |                | Work pace |                | Stress |                |
|                                    | N            | Percentage (%) | N         | Percentage (%) | N         | Percentage (%) | N      | Percentage (%) |
| Low                                | 11.0         | 1<br>2.5       | 166.0     | 1<br>37.5      | 139.0     | 1<br>31.4      | 212.0  | 1<br>47.9      |
| Moderate                           | 49.0         | 4<br>11.1      | 75.0      | 4<br>16.9      | 288.0     | 4<br>65.0      | 189.0  | 4<br>42.7      |
| High                               | 383.0        | 9<br>86.4      | 202.0     | 9<br>45.6      | 16.0      | 9<br>3.7       | 39.0   | 9<br>8.8       |
| Very high                          | 0.0          | -<br>0.0       | 0.0       | -<br>0.0       | 0.0       | -<br>0.0       | 3.0    | 16<br>0.7      |

N = 443

## DISCUSSION

### RULA

The findings showed that more than 61.9% of elderly taxi drivers are driving in an awkward posture condition that requires investigation and changes soon on driving behaviour at the action level 3. Meanwhile, 23.5% of elderly taxi drivers is at action level 4 which explains that investigations and driving changes are required immediately. There is a similar study result using the Rapid Entire Body Assessment (REBA) technique and RULA of 46.0% high risk bus driver at action level 3 to experience MSD and require modification on the driving space or driving mode [22]. Physical fatigue and MSDs among drivers are caused by inappropriate driving posture [23, 24]. Previous research [25] mentioned that seating features such as surface, shape, type of back rest angle, spine support, steering control (steering and pedal), eye view and availability of headroom may affect driving posture.

### QEC

The body parts which scored a very high level of exposure is neck (20.8%) and followed by truck (6.5%) in the static movement. On the contrary to the study conducted [26], shoulder part are the highest and followed by wrists. While the body parts at the highest exposure score were the neck (76.5%), shoulders (55.0%) and back (49.9%) in the static movement. However, there are similarities

with previous studies on the back areas which received the most complaints at high exposure score [26].

The researchers [27, 28] also explained that ergonomic interventions are indispensable whereby effective effects to reduce the risk of MSDs on the neck, wrist, shoulder, lower back, and elbow is strictly required. There are many studies that have been done regarding MSD related to age factor, amongst them: muscle movement and tendon muscle flexibility decreased with age [29, 30], muscle strength showed a drastic reduction at the age of 50 years [31] and recovery periods take time on spinal muscle tissue [32]. Other factors showed high score at exposure level was driving (86.4%) and vibration (45.6%). There is less difference in the study conducted [26] using QEC techniques whereby a percentage that receives high complaints on other factor disclosures is driving and vibration. The risk factor for the problem of MSD among drivers is different between each country, this is due to differences in racial, geographic, ethnicity and socio-demographic [33]. There are many physical factors that cause the problem of MSD recorded among elderly [32, 34, 35] and vibrations for the whole body [15, 36, 37]. The entire body's vibration due to long-term working exposure is associated with an increased risk of spinal disorders and associated with muscle system [38, 39, 40]. The previous study also found

that lower exposure body vibration may reduce the potential to develop low back pain symptoms [41].

## CONCLUSION

In general, this study offered insights on the characteristic of the elderly taxi drivers in particular to identify risk factors that may cause injury or pain on sitting posture due to discomfort seating design in Peninsular Malaysia. Result from RULA and QEC showed current driving posture may lead to MSD. More exploration needed to investigate this topic that will benefit taxi drivers especially the elderly community to improve their quality of life and also in the context of safety and health. Through an ergonomics point of view, the intervention approach shall reduce MSD-related problems that give us some concrete basis to do further research on this topic.

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## COMPETING INTERESTS

There is no conflict of interest.

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