A SYSTEMATIC LITERATURE REVIEW ON THE USE OF AN AGRICULTURAL ERGONOMICS RISK ASSESSMENT TOOLS

Anuwat Akkeesuwan[1], Klangduen Pochana[2], and Supapan Chaiprapat[3], Nutjaree Saejiw[4]

[123]Faculty of Industrial Engineering, Prince of Songkla University,
Khohong, Hatyai 90112, Songkla, Thailand.

[4]Faculty of Science and Industrial Technology, Prince of Songkla University,
Makhamtia, Muang 84000, Suratthani, Thailand.

Corresponding Author's Email: [1]ianuwatak@gmail.com

ABSTRACT: This article reports on a systematic literature review. It aims to study the overview of an ergonomics risk assessment tools among agricultural harvesters. Musculoskeletal disorders are a common significant health problem in many countries worldwide. There are many reports in an ergonomics field that indicated that the size of this problem was likely increased too high and it was also found out that it directly resulted in inefficient work. The agricultural industry is still a dangerous and harvesters around the world still have a high risk of an injury work-related ergonomics risk factors. Especially, working postures itself is not common and a threat to health from work that affects the occurrence of musculoskeletal disorders. There are several factors associated such as repetitive motion, excessive force, lifting, movement, and prolonged sitting or standing. This article aims to study common assessment tools such as RULA, REBA, QEC, AWBA which are currently used as ergonomics risk assessment tools. The articles focused in this study are published in the English language only in 2001 to 2018 including the Web of Science, Scopus, and Science Direct databases. The selected articles are related to agricultural work. The result was that the current an ergonomics risk assessment tools are of various type. Information about an agricultural ergonomics risk assessment tools need to be collected and analyzed in a more systematic way in order to contribute for a deeper understanding.

KEYWORDS: *Musculoskeletal Disorders (MSDs); Ergonomics; Risk Assessment; Agricultural.*

1.0 INTRODUCTION

Agriculture is still a dangerous industry and farmers around the world still have a high risk of injury work-related Ergonomic risk factors, especially work postures is a threat to health from work that affects the occurrence of musculoskeletal disorders. This study refers to an ergonomics in agricultural harvesting but not about farm works.[1][2] The work-related musculoskeletal disorders and symptoms in the working population are common, occurring predominantly in the low back, neck and upper limbs -an important cause of worker disability and absenteeism groups. These disorders include a large number of inflammatory and degenerative conditions. The muscles, tendons, ligaments, joints, peripheral nerves and blood vessels are also effected.[3] The frequent ones are physical, individual, and psychosocial risk factors that are associated with the development of work-related musculoskeletal disorders.[4] The physical risk factors include the physical demands imposed by the performing task, such as adoption, frequency, and repetition of movement, task duration, and vibration experience.[5] There are current ergonomic risk assessment tools restrictions on the use of causing the operator not to participate in the assessment of exposure to risk factors. An ergonomics applied in health preventive action will improve the quality of life for many workers.[6] This article considers only research on ergonomics risk assessment tools, comparing the different type of an ergonomics risk assessment tools that are currently used. From research studies, it was found out that the most common in an industrial

whenever not found in an agricultural. This must be a tool observational assessment only. The purpose of this work is to literature review revealed a gap in the existing methods.

2.0 METHODS

This literature review included an article that met the inclusion criteria stated below. Papers published in the English language only in 2001 to 2018 including the Web of Science, Scopus, and Science Direct databases. The articles are related to agricultural works.

3.0 RESULTS

Many researchers have studied methods of preventing these musculoskeletal diseases. As a result, various ergonomics risk assessment tools are capable of fast, easy, self-direct measurement, cover factors related, and accurate evaluation of work-related activities.

3.1 RULA *[Rapid Upper Limb Assessment]*

RULA is an ergonomics survey method. It aims to investigate workplaces and evaluate the degree of working posture only on 3 stages of the Upper Limb muscles groups, with Neck, Trunk [Upper-Lower Back], Leg, Hands [Upper-Lower Arms], as well as the ability to assess the workload. Which can indicate the degree of danger or risk level to the body caused by the work of the employees as well.[7]

This method with 2 groups are group A is an evaluated Hands [Upper-Lower Arms and Wrist] analysis; whenever not including Shoulders and Elbows analysis and group B is an evaluated Neck, Trunk and Leg analysis; whenever not including the Hips, Thighs, Knees, Ankles and Feet analysis, which can be divided into 3 stages. The first stage was selected of the most difficult working postures. The longest period of time that the posture sustained and the posture where the highest loads occur for assessment. The second stage was the scoring of the selected posture by using the scoring evaluation form, body-part diagrams and table provided in the RULA employee assessment evaluation form. The third stage was the grand total scores converted into action level in the final. The assessment method scores twice as the workers involved both sides of the limbs to perform their task to get the average total scores for classification of action level.[2][3][7]

Whenever it was not found out that an assessment of Personal Factors, Physical Factors, Psychosocial Factors, Posture Duration, Field Condition, Environmental Factors, and Nutritional Status to better assess the occupational risks.[3][8] From this study of relevant research, it was found out that evaluation form was used for an ergonomics risk assessment for an industry such as office work and computer-related tasks and etc.[3], [7] The RULA method is suitable for an assessment of postural upper limb disorders, neck trunk and leg in relation to the muscular action and external loads applied to the body. Due to the difficulty of the tasks, harvesters are to be more difficult and perform carried out exposure interaction with tools, machines, and environments. So that agriculture requires attention to specific methods that consider the characteristics of these activities for agricultural harvesting.[8][9]

3.2 REBA *[Rapid Entry Body Assessment]*

REBA is an ergonomics risk assessment tool. It aims to evaluate the degree of working posture only on 2 stages of the Entry Body muscles groups, with Neck, Trunk [Upper-Lower Back], Leg, Hands [Upper-Lower Arms and Wrist], as well as the ability to assess the workload and excessive force, which can indicate the degree of danger or risk level to the body caused by the work of the employees as well.[1][3]

This method with 2 groups are group A is an evaluated Neck, Trunk [Upper-Lower Back] and Legs analysis; whenever not including the Hips, Thighs, Knees, Ankles and Feet analysis and group B

is an evaluated Hands [Upper-Lower Arms] and Wrist analysis; whenever not including the Shoulders and Elbows analysis, which can be divided into 3 stages. The first and second stage was selected and each body part is scored according to its range of movement. The third stage is the highest scores are given to the body parts where presence of risk factors are more and lower scores are given to those where presence of risk factors are minimum. The assessment method scores twice as the workers involved both sides of the limbs to perform their task to get the average total scores for classification of action level were divided into five 0, 1, 2, 3, and 4 are categories: negligible, low, medium, high and very high. medium, high and very high needed an immediate action to keep away from any musculoskeletal disorder. However, for the lower extremities, only two classes are scored: whether the load is distributed to both feet or only to one foot, with one point given for every 30° of knee flexion. As a result, this tool is mainly limited to the upper extremities and does not take into account the various postures of the lower extremities. Despite this, REBA claims to be a whole-body evaluation tool.[3][10]

Whenever it was not found out that are an assessment of Personal Factors, Posture Duration, Field Condition, Environmental Factors, and Nutritional Status to better assess the occupational risks.[3][8] From this study of relevant research found that evaluation form was used to an ergonomics risk assessment for general works who perform their work in various unsupported and unpredictable postures, such as service work and service work-related tasks and etc. The REBA method is applied to identify and suitable for an assessment of postural entry body disorders such as neck trunk leg and hands in relation to the muscular action and external loads applied to the body and to the type of grip. Due to the difficulty of the tasks, harvesters are to be more difficult and perform carried out exposure interaction with tools, machines, and environments. So that agriculture requires attention to specific methods that consider the characteristics of these activities for agricultural harvesting.[8][9]

3.3 QEC *[Quick Exposure Check]*

QEC is an ergonomics observational tool. It aims to evaluate the degree of working posture, focuses primarily on physical workplace factors, but also includes the evaluation of psychosocial factors on 2 stages of the Entry-Body muscles groups, with Neck, Trunk [Upper-Lower Back], Hands [Upper-Lower Arms and Shoulder], as well as the ability to assess the workload, which can indicate the scoring system and exposure levels to the body caused by the work of the employees as well.[1]

This method with 2 parts are part I is an observer is assessment an evaluated level scores from question topic A, B, C, D, E, F and G respectively; for an evaluated Neck, Trunk [Upper-Lower Back], Hands [Upper-Lower Arms and Shoulder] analysis; whenever not including Elbows, Hips, Thighs, Knees, Ankles and Feet analysis and part II is worker is assessment an evaluated level scores from question topic H, J, K, L, M, N, P and Q respectively, which can be divided into 2 parts on sheet I, separated; Part I was selected of the most high risk working postures, select A [A1-A3], when performing the Trunk [Upper-Lower Back] either B [B1-B2], when seated or standing stationary tasks or B [B3-B5], when lifting, pushing/pulling and carrying tasks; Select C [C1-C3], when performing the Hands [Upper-Lower Arms and Shoulder] and select D [D1-D3], when performing the Shoulder/Arm movement; select E [E1-E2], when performing the Wrist and select F [F1-3], when they are similar motion patterns repeated; and the lasted select G [G1-G3], when performing the Head/Neck bent or twisted and Part II was selected of the question topic H [H1-H4] when performing the maximum weight handled manually; select J [J1-J3], when performing on average working time; select K [K1-K3], when performing force exerted by one hand; select L [L1-L2], when performing the visual demand; select M [M1-M3], when performing the vehicle driving; select N [N1-N3], when performing the vibration; select P [P1-P3] and Q [Q1-Q4], when

performing psychosocial factors; on sheet II, it was the grand total scores converted into exposure scores in the final.[6]

Whenever it was not found out about an assessment of Personal Factors. From this study of relevant research, it was found out that evaluation form was used for an ergonomics risk observation for general works. Despite this, QEC claims to be all the element of a work system. The QEC method has the ability to take into account work characteristics like posture, weight/effort force applied, frequency, duration, movements, psychosocial factors, and worker's perception/opinion, which may result in bias due to differences in perception. This results in a more comprehensive and detailed analysis of workers/workstations. However, The QEC method is applied to identify and suitable for an assessment of postural entry body disorders such as neck trunk and hands in relation to the muscular action and external loads applied to the body and to the type of grip. Due to the difficulty of the tasks, harvesters are to be more difficult and perform carried out exposure interaction with tools, machines, and environments. So that agriculture requires attention to specific methods that consider the characteristics of these activities for agricultural harvesting.[8][9] Moreover, this resulted in the QEC method obtaining a greater portion of the high-risk category in assessing risk of MSDs. In other words, QEC is non-comprehensive.

3.4 AWBA *[Agricultural Whole-Body Assessment]*

AWBA is an ergonomics risk assessment method. It aims to evaluate the assessing various postures commonly assumed in agricultural works only and claims to be a whole-body evaluation tool. The verification of the assessment tools will contribute to the enhancement of the quality of activities designed to prevent and control work-related musculoskeletal diseases in other industries.

This method designed by combined AULA and ALLA then presents AWBA, with III parts are part I is the Upper-Limb assessment, part II is the Lower-Limb assessment and part III is the grand total risk level converted into action level in the final.[1]
Whenever it was not found out about an assessment of Personal Factors and Physical Factors. From this study of relevant research, it was found out that evaluation form was used for an ergonomics risk assessment for an agricultural with farm works only, but not including agricultural harvesting works. The AWBA method is applied to identify and be suitable for an assessment of postural entry body disorders in relation to the muscular action and external loads. Due to the difficulty of the tasks, harvesters are to be more difficult and perform carried out exposure interaction with tools, machines, and environments. AWBA highlighted how biomechanical workload in the interaction with the working activities is limited to the upper part of the body and it determines an important involvement especially of the wrist, leg, forearm, and on the chest; Due to flexion of the chest and postural asymmetries. So that agriculture requires attention to specific methods that consider the characteristics of these activities for agricultural harvesting.[8][9]

4.0 DISCUSSION AND CONCLUSION

Many an ergonomics risk factors contribute to work-related musculoskeletal disorders (WMSDs) including high forces, awkward posture, repetitive and long duration task and exposure to vibration during working. Therefore, exposure risk assessment is a crucial step in protecting workers from developing WMSDs. Procedures and tools for assessing the ergonomics risk of WMSDs based on parameter related to many factors including purpose of the tool, the body regions, types of jobs the tool is appropriate for, the expected output of the tool and limitations of the tool.

Agricultural harvesters interact with a variety of tasks. In this study, it was found out about an ergonomics risk assessment tools in several works, which each tool has different limitations. A

comparison of both are difference of an ergonomics risk assessment tools with the traditional method is RULA/REBA and currently method is QEC/AWBA used in existing, it was found out that it is similarly used in an general works or agricultural works. Finally, in conclusion; There are several ergonomics risk assessment tools in studies of musculoskeletal disorder in industrial. Whenever it was found out that a little in an agricultural work resulting from new method may affect the assessment of work in an agricultural works.

Ergonomic risk factors affect the occurrence of diseases and musculoskeletal disorders from the work of an agricultural harvester. Therefore, choosing to use an ergonomics risk assessment tool with correct and proper work by considering an objective of each risk assessment tool; such as, body proportion and type of work that need to be assessed must be appropriate with the type of there risk assessment tool. Resulting from the assessment and limitations of the tool will be allowed an agricultural harvester and related parties to know ergonomics risk factors from work to find ways to prevent further problems.

5.0 REFERENCES

[1] Y.-K. Kong, S.-J. Lee, K.-S. Lee, G.-R. Kim, and D.-M. Kim, "Development of an Ergonomics Checklist for Investigation of Work- Related Whole-Body Disorders in Farming - AWBA: Agricultural Whole-Body Assessment," *J. Agric. Saf. Health*, vol. 21, no. 4, pp. 207–215, 2015.

[2] N. S. Mohd Nasir *et al.*, "Association of Workplace Stressors with Salivary Alpha-Amylase Activity Levels among Fresh Fruit Bunch Cutters in Selangor," *Iran. J. Public Health*, vol. 45, pp. 68–76, Feb. 2016.

[3] Y.-K. Kong, S. Lee, K.-S. Lee, and D.-M. Kim, "Comparisons of ergonomic evaluation tools (ALLA, RULA, REBA and OWAS) for farm work," *Int. J. Occup. Saf. Ergon.*, vol. 24, no. 2, pp. 218–223, Apr. 2018.

[4] E. Kim, A. Freivalds, F. Takeda, and C. Li, "Ergonomic Evaluation of Current Advancements in Blueberry Harvesting," *Agronomy*, vol. 8, no. 11, p. 266, Nov. 2018.

[5] "An observational method for Postural Ergonomic Risk Assessment (PERA) - ScienceDirect." [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0169814116302657?via%3Dihub. [Accessed: 03-Jun-2019].

[6] G. David, V. Woods, G. Li, and P. Buckle, "The development of the Quick Exposure Check (QEC) for assessing exposure to risk factors for work-related musculoskeletal disorders," *Appl. Ergon.*, vol. 39, no. 1, pp. 57–69, Jan. 2008.

[7] L. McAtamney and E. Nigel Corlett, "RULA: a survey method for the investigation of work-related upper limb disorders," *Appl. Ergon.*, vol. 24, no. 2, pp. 91–99, Apr. 1993.

[8] S. M. Taghavi, H. Mokarami, O. Ahmadi, L. Stallones, A. Abbaspour, and H. Marioryad, "Risk Factors for Developing Work-Related Musculoskeletal Disorders during Dairy Farming," *Int. J. Occup. Environ. Med.*, vol. 8, no. 1, pp. 39–45, Jan. 2017.

[9] M. Cheta, M. V. Marcu, and S. A. Borz, "Workload, Exposure to Noise, and Risk of Musculoskeletal Disorders: A Case Study of Motor-Manual Tree Feeling and Processing in Poplar Clear Cuts," *Forests*, vol. 9, no. 6, p. 300, Jun. 2018.

[10] S. Hignett and L. McAtamney, "Rapid Entire Body Assessment (REBA)," *Appl. Ergon.*, vol. 31, no. 2, pp. 201–205, Apr. 2000.