A REVIEW ON INITIAL ERGONOMIC RISK ASSESSMENT (INERA) REPORT FOR RUBBER-BASED MANUFACTURING INDUSTRY IN KLANG VALLEY, SELANGOR

By

RAJA NUR 'AQILAH BINTI RAJA ANUAR

Thesis Submitted to

College of Business

Universiti Utara Malaysia,

in Partial Fulfillment of the Requirement for the Master of Science (Management)

Pusat Pengajian Pengurusan Perniagaan
SCHOOL OF BUSINESS MANAGEMENT
Universiti Utara Malaysia

PERAKUAN KERJA KERTAS PENYELIDIKAN
(Certification of Research Paper)

Saya, mengaku bertandatangan, memperakukan bahawa
(I, the undersigned, certified that)
RAJA NUR 'AQILAH BINTI RAJA ANUAR (830136)

Calon untuk Ijazah Sarjana
(Candidate for the degree of)
MASTER OF SCIENCE (OCCUPATIONAL SAFETY AND HEALTH MANAGEMENT)

telah mengemukakan kertas penyelidikan yang bertajuk
(has presented his/her research paper of the following title)

A REVIEW ON INITIAL ERGONOMIC RISK ASSESSMENT (INERA) REPORT FOR RUBBER-BASED MANUFACTURING INDUSTRY IN KLANG VALLEY, SELANGOR

Seperti yang tercatat di muka surat tajuk dan kulit kertas penyelidikan
(as it appears on the title page and front cover of the research paper)

Bahawa kertas penyelidikan tersebut boleh diterima dari segi bentuk serta kandungan dan meliputi bidang ilmu dengan memuaskan.
(that the research paper acceptable in the form and content and that a satisfactory knowledge of the field is covered by the research paper).

Nama Penyelia : **DR. MARZIAH BT. ZAHAR**
(Name of Supervisor)

Tandatangan :
(Signature)

Tarikh : **11 OGOS 2024**
(Date)

PERMISSION TO USE

In presenting this thesis in fulfilment of the requirements for a Post Graduate degree from Universiti Utara Malaysia (UUM), I agree that the Library of this university may make it freely available for inspection. I further agree that permission for copying this thesis in any manner, in whole or in part, for scholarly purposes may be granted by my supervisor(s) or in their absence, by the Director of Postgraduate Studies Unit, College of Business where I did my thesis. It is understood that any copying or publication or use of this thesis or parts of it for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and to the UUM in any scholarly use which may be made of any material in my thesis.

Request for permission to copy or to make other use of materials in this thesis in whole or in part should be addressed to:

Dean of Othman Yeop Abdullah Graduate School of Business

Universiti Utara Malaysia

06010 UUM Sintok

Kedah Darul Aman

ABSTRACT

Malaysia is ranked in the 8th position among the world's top ten producers of natural rubber. The process of mixing, moulding, finishing and office is chosen as workunit for this research. Based on the process and work unit to manufacture rubber products, it may expose production operators to ergonomic risks and hazards. Hence, this study aimed to investigate the trend of musculoskeletal disorders (MSDs) and the prominent ergonomic risk factor that affects MSDs. Apart from that is to recommend as well as conclude the best practices to reduce the MSDs in the rubber manufacturing sector in Klang Valley, Selangor. This study utilized qualitative content analysis based on reliable secondary data: Initial Ergonomic Risk Assessment (INERA) Report produced by a DOSH-approved and recognized ergonomic trained person. Three INERA reports from the rubber manufacturing industry located in Klang Valley were chosen as the samples for the study. Thematic analysis was employed to identify the elements required for this study. The findings revealed two big themes: musculoskeletal discomfort area and ergonomic risk factors. It then contributed to a sub-theme which are four work units – mixing, moulding, finishing, and office. The study outcomes will contribute to the trend of musculoskeletal disorder, the most prominent ergonomic risk, and the recommended control measure for this issue. Future studies may require investigating the ergonomic assessment in the rubber manufacturing industry of other states in Malaysia and other industries.

Keywords: Ergonomic risk assessment, Musculoskeletal disorder, Rubber manufacturing industry

ABSTRAK

Malaysia berada di kedudukan ke-8 antara sepuluh pengeluar getah asli terbaik dunia. Proses pembuatan produk getah seperti proses pencampuran, proses pengacuan, proses kemasan dan unit kerja pejabat merupakan unit kerja yang terlibat dalam kajian ini. Berdasarkan unit kerja dan proses pembuatan produk getah tersebut, ia mempunyai potensi untuk mendedahkan pekerja di bahagian perkilangan kepada risiko dan bahaya ergonomik. Oleh yang demikian, kajian ini bertujuan untuk menyiasat trend gangguan muskuloskeletal, faktor risiko ergonomik yang ketara dan mempengaruhi gangguan musculoskeletal. Selain itu, untuk mengesyorkan serta merumuskan amalan terbaik untuk mengurangkan gangguan muskuloskeletal dalam sektor pembuatan getah di Lembah Klang, Selangor. Kajian ini menggunakan analisis kualitatif berdasarkan data sekunder yang boleh dipercayai : Laporan Penilaian Risiko Ergonomik Permulaan yang dihasilkan oleh orang ergonomik yang terlatih yang diluluskan dan diiktiraf oleh Jabatan Keselamatan dan Kesihatan Pekerjaan (JKKP). Tiga laporan yang dipilih sebagai sampel kajian tersebut adalah terdiri daripada industri pembuatan getah yang terletak di Lembah Klang. Analisis tematik digunakan untuk mengenal pasti elemen yang diperlukan dalam kajian ini. Penemuan mendedahkan dua tema besar: Kawasan ketidakselesaan musculoskeletal dan faktor risiko ergonomik. Ia kemudiannya menyumbang kepada sub-tema iaitu empat unit kerja – pencampuran, pengacuan, kemasan dan pejabat. Hasil kajian akan menyumbang kepada trend gangguan muskuloskeletal, risiko ergonomik yang paling kritikal dan langkah kawalan yang disyorkan untuk isu ini. Kajian masa hadapan mungkin memerlukan penyiasatan penilaian ergonomik dalam industri pembuatan getah di negeri lain dalam Malaysia serta industri perkilangan yang lain.

Kata Kunci: Penilaian risiko ergonomik, Penyakit muskuloskeletal, Industri pembuatan getah

ACKNOWLEDGEMENT

This study was successful due to the significant number of people who assisted and guided the researcher throughout the accomplishment of this study. First and foremost, I am grateful to the Almighty God for his strength and guidance which I am using to accomplish this research project. I am indebted, especially to Dr Marziah Binti Zahar, who has been supportive by sharing her pearls of wisdom during the course of this research. She has served as both my mentor and lecturer and I will never be able to give credits for all that she has taught me. She has demonstrated to me what an excellent lecturer (and person) ought to be by the way of her example.

Nobody has been more important to me in the pursuit of this project rather than the members of my family. I express my gratitude to my parents for their unwavering love and support in all of my endeavours. They are the ultimate role models. Most importantly, I would like to thank my fellow friends who helped in giving moral support as well as assistance in completing this research.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ADERA	Advanced Ergonomic Risk Assessment
CMDQ	Cornell Musculoskeletal Discomfort Questionnaire
DALY	Disability Adjusted Life Years
DOSH	Department of Occupational Safety and Health
ERF	Ergonomic Risk Factor
INERA	Initial Ergonomic Risk Assessment
MSD	Musculoskeletal Disorder
NMQ	Nordic Musculoskeletal Questionnaire
OSHA	Occupational Safety and Health Act
OWAS	Ovako Working Posture Analyzing System
REBA	Rapid Entire Body Assessment
RULA	Rapid Upper Limb Assessment
SARS	Severe Acute Respiratory Syndrome
SCT	Social Cognitive Theory
SOCSO	Social Security Organisations
WRMSD	Work Related Musculoskeletal Disorder

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter will address the following topics: the study background, problem statement, research questions, objectives of study, the study significance, scope of study, operational variables, and the organizational of study.

1.2 Background of Study

Rubber can be broadly classified into two main categories which are natural rubber that is obtained from the latex of *Hevea brasiliensis*, sharinga tree, seringueira, or most commonly named rubber tree species and typically used in the production of various types of rubber products such as tires, automotive parts and gloves, while the other one is synthetic rubber that is derived from petroleum by-products and mainly utilized in the production of rubber products either as an alternative to or complementing natural rubber. The rubber-based products industry in Malaysia is divided into five sub-sectors: rubber footwear, general rubber products, industrial rubber products, tires and tire-related products and latext products. (MITI, 2023).

According to Kawano (2018), Malaya started its first rubber plantation in 1896, and due to the increasing need for automobile tires worldwide, rubber planting spread through Southeast Asia, particularly in Malaysia and Indonesia. After World War II, petroleum-based synthetic rubber started to replace natural rubber, which resulted in a temporary decline in the use of natural rubber. However, during the 1980s, the adoption of radical tires, “oil shocks” high crude oil prices, and re-evaluations of the benefits of

REFERENCES

Abdullah, N. H., Hamid, N. a. A., Wahab, E., Shamsuddin, A., & Asmawi, R. (2018). Work-related Musculoskeletal Disorder (WRMD) among Production Operators: Studies of Differences in Age and Gender. *Journal of Physics. Conference Series*, 1049, 012023. https://doi.org/10.1088/1742-6596/1049/1/012023

Afifehzadeh-Kashani H, Choobineh A, Bakand S, Gohari MR, Abbastabar H, Moshtaghi P. [Validity and Reliability Farsi Version Cornell Musculoskeletal Discomfort Questionnaire (CMDQ)]. Iran Occupational Health Journal. 2011;7(4):69–75. Persian

Alarab, A., & Taqatqa, N. (2023). *Perspective chapter: Resistance Exercises for Musculoskeletal Disorders. In IntechOpen eBooks.* https://doi.org/10.5772/intechopen.110166

Alasim, H. N., Nimbarte, A. D., & Jaridi, M. (2019). Impact of pulling direction and magnitude of force exertion on the activation of shoulder muscles. *International Journal of Industrial Ergonomics, 69, 14-22.*

Amell, T., & Kumar, S. (2001). Work-related musculoskeletal disorders: design as a prevention strategy. Journal of Occupational Rehabilitation.11, 255–265.

Amick BC III et al (2003) Effect of ofce ergonomics intervention on reducing musculoskeletal symptoms. Spine 28(24):2706–2711

Amin, M., & Zarka, A. (2017). Women Workers in Malaysia's Private Sector. *Enterprise Surveys*, 35.

Ayre, C., & Scally, A. J. (2014). Critical values for LawsHe's Content Validity ratio. Measurement and Evaluation in Counseling and Development, 47(1), 79–86. https://doi.org/10.1177/0748175613513808

Ayub, Y., & Shah, Z. A. (2018). Assessment of work-related musculoskeletal disorders in the manufacturing industry. Journal of Ergonomics, 08(03). https://doi.org/10.4172/2165-7556.1000233

Aziz, F. A., Razali, N., & Jaafar, N. N. (2016). An investigation of low ergonomics risk awareness, among staffs at early product development phase in Malaysia automotive industries. IOP Conference Series. Materials Science and Engineering, 114, 012096. https://doi.org/10.1088/1757-899x/114/1/012096

Baharuddin, N. A., Noor, U., Abdullah, U. N. N., & Othman, N. (2019). INVESTIGATING ERGONOMICS RISKS IN SYNTHETIC GLOVES PACKAGING WORKSTATION. ResearchGate. https://www.researchgate.net/publication/341480246_INVESTIGATING_ERGONOMICS_RISKS_IN_SYNTHETIC_GLOVES_PACKAGING_WORKSTATION

Behdani, M., Gholamnia, R., & Saremi, M. (2023). Effects of ergonomic interventions on health indicators in a rubber industry. *Archives of Occupational Health.* https://doi.org/10.18502/aoh.v7i1.14293

Bernardes JM, Ruiz-Frutos C, Moro ARP, Dias A (2021) A low-cost and efcient participatory ergonomic intervention to reduce the burden of work-related musculoskeletal disorders in an industrially developing country: an experience report. Int J Occup Saf Ergon 27(2):452–459

Biradar, V. G., Hebbal, S. S., & Qutubuddin, S. M. (2024). Ergonomic Risk Identification and Postural Analysis in Electrical Transformers Manufacturing Company located in Southern India. International Journal of Occupational Safety and Health, 14(2), 144–151. https://doi.org/10.3126/ijosh.v14i2.53692

Carrillo-Castrillo, J.A., et al., Estimation of the relative risks of musculoskeletal injuries in the Andalusian manufacturing sector. *International Journal of Industrial Ergonomics*, 2016. 52: p. 69-77.

Chatfield, S. L. (2020, March 28). Recommendations for secondary analysis of qualitative data. NSUWorks. https://nsuworks.nova.edu/tqr/vol25/iss3/17/

Chen, J., Qiu, J., & Ahn, C. (2017). Construction worker's awkward posture recognition through supervised motion tensor decomposition. *Automation in Construction*, 77, 67-81.

Choobineh, A., Tabatabaei, S. H., Mokhtarzadeh, A., & Salehi, M. (2007). Musculoskeletal Problems among Workers of an Iranian Rubber Factory. *Journal of Occupational Health*, 49(5), 418–423. https://doi.org/10.1539/joh.49.418

Clinics, S. J. P. (2021, January 3). Musculoskeletal disorders in the workplace and prevention. *St. Joseph's Physiotherapy Clinics*. https://stjosephsphysio.com/physio-blog/f/musculoskeletal-disorders-in-the-workplace-and-prevention

Creswell, J., W. (2014). Research design: Qualitative, quantitative, and mixed methods approaches. doi:10.1007/s13398-014-0173-7.2

Das, S., Moorthy, M. K., & Shanmugaraja, K. (2023). Analysis of musculoskeletal disorder risk in cotton garment industry workers. Journal of Natural Fibers, 20(1). https://doi.org/10.1080/15440478.2022.2162182

De Cássia Pereira Fernandes, R., Carvalho, F. M., & Assunção, A. Á. (2011). Prevalence of musculoskeletal disorders among plastics industry workers. Cadernos De Saúde Pública, 27(1), 78–86. https://doi.org/10.1590/s0102-311x2011000100008

Department of Occupational Safety and Health. (2008). Guideline for Occupational Hazard, Risk Assessment and Risk Control (HIRARC). https://www.dosh.gov.my/index.php/legislation/guidelines/hirarc-2/1846-01-guidelines-for-hazard-identification-risk-assessment-and-risk-control-hirarc-2008/file

Department of Occupational Safety and Health [DOSH]. (2024). Official website Department of Occupational Safety and Health - Initial Ergonomics Risk Assessment. https://www.dosh.gov.my/index.php/recognized-list/recognized-list-sub/ergonomic-trained-person/initial-ergonomics-risk-assessment

Department of Occupational Safety and Health, Ministry of Human Resources, Malaysia. (2017). *Guideline on Ergonomic Risk Assessment at Workplace. Department of Occupational Safety and Health, Ministry of Human Resources.* https://www.dosh.gov.my/index.php/legislation/guidelines/ergonomic/2621-01-guidelines-on-ergonomics-risk-assessment-at-workplace-2017/file

Department of Statistics Malaysia. Occupational Accident Statistic 2020. Retrieved from: https://www.dosh.gov.my/index.php/statistic-v/occupational-accident-statistics/occupational-accident-statistic-2020; 20 May,2020

Deros, B.M., D.D.I. Daruis, I.M. Basir, A Study on Ergonomic Awareness among Workers Performing Manual Material Handling Activities. Procedia - Social and Behavioral Sciences, 2015. 195: p. 1666-1673.

Dollard, M.F., D.Y. Neser, Worker health is good for the economy: Union density and psychosocial safety climate as determinants of country differences in worker health and productivity in 31 European countries. *Social Science & Medicine*, 2013. 92: p. 114-123.

Donini, A. (2019). The place to exercise collective rights: the "business unit" in the fragmented enterprise. DOAJ (DOAJ: Directory of Open Access Journals). https://doi.org/10.6092/issn.2421-2695/10224

Dosm. (2024, June 11). Department of Statistics Malaysia. https://www.dosm.gov.my/portal-main/release-content/monthly-rubber-statistics-apr2024-

Downe-Wamboldt, B. (1992). Content analysis: Method, applications, and issues. Health Care for Women International, 13(3), 313–321. https://doi.org/10.1080/07399339209516006

Elnour Yassen, M., & Md. Jahi, J. (2007). Investigation of Variations and Trends in TSP Concentrations in The Klang Valley Region, Malaysia. Malaysian Journal of Environmental Management, 57–68.

Ergonomics Trained Person (ETP). (n.d.). https://www.dosh.gov.my/index.php/contact-us/faq?view=topic&id=570

Ezugwu, U. A., Egba, E. N., Igweagu, P. C., Eneje, L. E., Orji, S., & Ugwu, U. C. (2020). Awareness of awkward posture and repetitive motion as ergonomic

factors associated with musculoskeletal disorders by health promotion professionals. *Global Journal of Health Science,* 12(6), 128. https://doi.org/10.5539/gjhs.v12n6p128

Faez, E., Zakerian, S. A., Azam, K., Hancock, K., & Rosecrance, J. (2021). An Assessment of Ergonomics Climate and Its Association with Self-Reported Pain, Organizational Performance and Employee Well-Being. International Journal of Environmental Research and Public Health/International Journal of Environmental Research and Public Health, 18(5), 2610. https://doi.org/10.3390/ijerph18052610

Freakley, P. K. (2012). Rubber processing and production organization. Springer Science & Business Media.

Friese S. Qualitative Data Analysis with ATLAS.ti. 3. ed. London: Sage, 2019.

G, Y., & Rajesh, R. (2014). Ergonomic interventions in a warehouse of a food processing industry. International Journal of Innovative Research in Science Engineering and Technology/International Journal of Innovative Research in Science, Engineering and Technology, 03(09), 15894–15902. https://doi.org/10.15680/ijirset.2014.0309015

Gangopadhyay, S. (2022). Application of cognitive ergonomics in communication. In Routledge eBooks (pp. 277–281). https://doi.org/10.4324/9781003033448-18

Gattamelata, D., & Fargnoli, M. (2022). Development of a new procedure for evaluating working postures: an application in a manufacturing company. International Journal of Environmental Research and Public Health/International Journal of Environmental Research and Public Health, 19(22), 15423. https://doi.org/10.3390/ijerph192215423

GBD 2016 Occupational Risk Factors Collaborators. Global and regional burden of disease and injury in 2016 arising from occupational exposures: a systematic analysis for the Global Burden of Disease Study 2016. Occup Environ Med. 2020;77(3):133–41.

GBD 2017 DALYs and HALE Collaborators. Global, regional, and national disability-adjusted life-years (DALYs) for 359 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990–2017: A systematic analysis for the Global Burden of Disease Study 2017. Lancet 2018, 392, 1859–1922.

Hair, J., R. & Money, A., S., P., & Page, M. (2007). Research methods for business.

Hamzah, Y. (2013). ErgoApps : A mobile application that create awareness and reminder on having ergonomic practices to avoid Work Related Musculoskeletal Disorders (WMSD). *Bachelor of Technology (Hons) (Information & Communication Technology)*.

Heaton, J. (2004). Reworking qualitative data. London, UK: Sage

Hierarchy of controls. (2022). National Institute for Occupational Safety and Health (NIOSH). https://www.cdc.gov/niosh/learning/safetyculturehc/module-3/2.html

Hosseini, Z. S., Tavafian, S. S., Ahmadi, O., & Maghbouli, R. (2023). Effectiveness of a theory-based educational intervention on work-related musculoskeletal disorders preventive behaviors among assembly-line female workers: a study protocol for a randomized controlled trial. Trials, 24(1). https://doi.org/10.1186/s13063-023-07391-0

Jaafar, R., Akmal, A., & Libasin, Z. (2021). ERGONOMICS KNOWLEDGE AMONG ENGINEERING STUDENTS IN PULAU PINANG MALAYSIA. *Journal of Modern Manufacturing Systems and Technology*, 5(2), 9–14. https://doi.org/10.15282/jmmst.v5i2.6658

Jaffar, N., Abdul-Tharim, A. H., Mohd-Kamar, I. F., & Lop, N. S. (2011). A literature review of ergonomics risk factors in construction industry. *Procedia Engineering*, *20*, 89-97.

Johnston, R. G., and Henry, B. E. (Eds.). (2009). Capturing campaign effects. University of Michigan Press

Kalakoski, V. (2019). Cognitive Ergonomics is a Matter of Cognitive Factors. SciSpace - Paper. https://typeset.io/papers/cognitive-ergonomics-is-a-matter-of-cognitive-factors-vtj2l3idl5

Kaur, M., Gupta, H., & Sudan, R. (2019). Ergonomic risk factors. *SciSpace - Paper*. https://typeset.io/papers/ergonomic-risk-factors-2cj02quq19

Kawano, M. (2019). Changing Resource-Based Manufacturing Industry: The case of the rubber industry in Malaysia and Thailand. In Emerging-economy state and international policy studies (pp. 145–162). https://doi.org/10.1007/978-981-13-2859-6_7

Kennedy, L. G., Kichler, E. J., Seabrook, J. A., Matthews, J. I., & Dworatzek, P. D. (2019). Validity and reliability of a food skills questionnaire. Journal of Nutrition Education and Behavior, 51(7), 857–864. https://doi.org/10.1016/j.jneb.2019.02.003

Kondracki, N. L., Wellman, N. S., & Amundson, D. R. (2002). Content Analysis: Review of methods and their applications in nutrition education. Journal of Nutrition Education and Behavior, 34(4), 224–230. https://doi.org/10.1016/s1499-4046(06)60097-3

Kreuzfeld, S., Seibt, R., Kumar, M., Rieger, A., & Stoll, R. (2016). German version of the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ): translation and validation. Journal of Occupational Medicine and Toxicology, 11(1). https://doi.org/10.1186/s12995-016-0100-2

Laaksonen, M., et al., Work Arrangements, Physical Working Conditions, and Psychosocial Working Conditions as Risk Factors for Sickness Absence: Bayesian Analysis of Prospective Data. *Annals of Epidemiology*, 2010. 20(5): p. 332-338.

Liu HC, Cheng Y, Ho JJ. Associations of ergonomic and psychosocial work hazards with musculoskeletal disorders of specific body parts: A study of general employees in Taiwan. International Journal of Industrial Ergonomics 2020;76:102935.

Lukiyanto, K., Pratama, A. R. F., & Ningrum, I. K. (2023). The challenges of applying ergonomics to small medium enterprises. E3S Web of Conferences, 388, 01012. https://doi.org/10.1051/e3sconf/202338801012

Malchaire, J., Cock, N., & Vergracht, S. (2001). Review of the factors associated with musculoskeletal problems in epidemiological studies. International archives of occupational and environmental health, 74(2), 79-90.

Manufacturing sector: Mixed trends, brighter outlook for 2024 - MIDA | Malaysian Investment Development Authority. (2024, March 6). MIDA | Malaysian

Investment Development Authority. https://www.mida.gov.my/mida-news/manufacturing-sector-mixed-trends-brighter-outlook-for-2024/

Maxwell, J. A. (2012). Qualitative Research Design : An Interactive Approach / J.A. Maxwell. ResearchGate. https://www.researchgate.net/publication/43220402_Qualitative_Research_Design_An_Interactive_Approach_JA_Maxwell

Md Deros B, Daruis DDI, Rosly AL, et al. Ergonomic risk assessment of manual material handling at an automotive manufacturing company. In: 2nd World Conference on Technology, Innovation and Entrepreneurship 2017; Istanbul, Turkey;21 December, 2020.

Md Zein, R., Rohani, J. M., Abidin, N. Z., & Rahman, I. A. (2019). Financial impact and causes of chronic MSD cases in Malaysia based on SOCSO claims record. In Advances in Intelligent Systems and Computing (Vol. 820). Springer International Publishing.

Mert, U., İde, D., & Gündüz, T. (2022). OTOMOTİV SEKTÖRÜ PROGRASİF KALIP HATTINDA ERGONOMİK ÜRETİM TASARIMI İLE VERİMLİLİĞİN ARTTIRILMASI. EndüStri MüHendisli Dergisi, 33(2), 289–308. https://doi.org/10.46465/endustrimuhendisligi.1037667

Ministry of Investment, Trade and Industry. (2023). Industrial Master Plan 2030 for Rubber-based Products industry. Ministry of Investment, Trade and Industry (MITI).

Mrc. (2024). Malaysian Rubber Council (MRC). MRC Official Website. https://www.myrubbercouncil.com/industry/world_production.php

Mohammadi, G. (2015). Analysis of Muscloskeletal symptom among workers in rubber industry. *SciSpace - Paper*. https://typeset.io/papers/analysis-of-muscloskeletal-symptom-among-workers-in-rubber-1z0r6n8vsa

National Occupational Accident and Disease Statistics 2021. (2022, June 30). Department of Statistics Malaysia Official Portal. https://v1.dosm.gov.my/v1/index.php?r=column/cthemeByCat&cat=492&bul_id=MkRoQ2IyZ0JkdElIZ0JidUhpaWxydz09&menu_id=WjJGK0Z5bTk1ZElVT09yUW1tRG41Zz09

Odebiyi, D. O., & Okafor, U. a. C. (2023). Musculoskeletal disorders, workplace ergonomics and injury Prevention. In IntechOpen eBooks. https://doi.org/10.5772/intechopen.106031

Official website Department of Occupational Safety and Health - Occupational Accident Statistic 2023. (n.d.). https://www.dosh.gov.my/index.php/statistic-v/occupational-accident-statistics/occupational-accident-statistic-2023

Okunribido O, Wynn T. Ageing and work-related musculoskeletal disorders. A review of the recent literature, HSE, 2010

Pavlovic-Veselinovic S, Hedge A, Grozdanovic M. An expert system for risk assessment of work-related musculoskeletal disorders. In: Khalid H, Hedge A, Ahram TZ, editors. *Advances in Ergonomics Modeling and Usability Evaluation*. Boca Raton: CRC Press; 2010

Productivity Improvement of Rubber Roller Mixing Process using Cause and Effect Analysis: A case study. (2016). CORE Reader, 2. https://core.ac.uk/reader/228971630

Qin, Z., Li, Y., & Yang, Y. (2023). Control. In Management for professionals (pp. 99–138). https://doi.org/10.1007/978-981-19-9231-5_4

Quadrini, F., Santo, L., & Musacchi, E. (2018). A sustainable molding process for new rubber products from tire recycling. Progress in Rubber, Plastics and Recycling Technology, 35(1), 41–55. https://doi.org/10.1177/1477760618798274

Rahman, I. A. (2022). The evaluation of worker satisfaction on usability of manual material handling equipment among manufacturing warehouse workers in Malaysia. AHFE International. https://doi.org/10.54941/ahfe1001713

Rambaree, K. and Faxelid, E. (2013). Considering Abductive Thematic Network Analysis with ATLAS.ti 6.2. In N. Sappleton (Ed.). Advancing Research Methods with New Media Technologies (pp. 170-186). Hershey PA, USA: IGI Global.

Rahco Rubber. (2016, August 4). Custom rubber mixing [Video]. YouTube. https://www.youtube.com/watch?v=vGRduLUuRco

Rostami, M., Choobineh, A., Shakerian, M., Faraji, M., & Modarresifar, H. (2021). Assessing the effectiveness of an ergonomics intervention program with a participatory approach: ergonomics settlement in an Iranian steel industry. International Archives of Occupational and Environmental Health, 95(5), 953–964. https://doi.org/10.1007/s00420-021-01811-x

Roth, G. B. (2014). Policy enforcement delays. SciSpace - Paper. https://typeset.io/papers/policy-enforcement-delays-22vfzjvmue

Rubber Molding Facilities Facility Viscon Rubber Pvt. Ltd Rubber gasket, Hoses, rings, Sheets Manufacturers. (n.d.). https://visconrubber.com/facilities/Rubber-Molding-Facilities

Segar, G., & Rahman, M. N. A. (2019). Musculoskeletal symptoms and ergonomic risk assessment among production operators at manufacturing industries: A review. IOP Conference Series. Materials Science and Engineering, 607(1), 012009. https://doi.org/10.1088/1757-899x/607/1/012009

Selamat, M. N., Akhir, N. M., Aziz, S. F. A., Jaaffar, A. H., & Baker, R. (2020). Reliable dimensions of ergonomic work system in the Malaysian manufacturing industries. *International Journal of Academic Research in Economics and Management Sciences,* 9(2). https://doi.org/10.6007/ijarems/v9-i2/7878

Shah, T. (2022). Ergonomics: An Overlooked Training. In Mastering Endo-Laparoscopic and Thoracospic Surgery (pp. 33–37). https://doi.org/10.1007/978-981-19-3755-2_6

Shikdar, A. A., & Al-Araimi, S. A. (2001). Ergonomic conditions in small manufacturing industries. Mağallaẗ Ǧāmiʿaẗ al-Sulṭān Qābūs Li-l-ʿulūm/Sultan Qaboos University Journal for Science, 6(1), 61. https://doi.org/10.24200/squjs.vol6iss1pp61-70

Sia, E., Ruslan, R., Nojumuddin, N. S., & Raja, Z. (2023). OSH Issues: Collection of Case Studies in Malaysia CHAPTER 5 ERGONOMIC RISK FACTORS AND MUSCULOSKELETAL.*ResearchGate*. https://www.researchgate.net/publication/378010713_OSH_Issues_Collection_of_Case_Studies_in_Malaysia_CHAPTER_5_ERGONOMIC_RISK_FACTO

RS_AND_MUSCULOSKELETAL_HEALTH_SYMPTOMS_AMONG_WIRE_ASSEMBLY_LINE_OPERATORS

Silviana, S., Hardianto, A., & Hermawan, D. (2022). The implementation of anthropometric measurement in designing the ergonomics work furniture. Eureka, Physics and Engineering./Eureka, Physics and Engineering, 3, 20–27. https://doi.org/10.21303/2461-4262.2022.001967

Social Security Organisation. (2021). Annual Report 2021. Retrieved July 7, 2024 from http://ww.perkeso.gov.my/en/report/annual-reports.html

Soratto, J., De Pires, D. E. P., & Friese, S. (2020). Thematic content analysis using ATLAS.ti software: Potentialities for researchs in health. Revista Brasileira De Enfermagem, 73(3). https://doi.org/10.1590/0034-7167-2019-0250

Stephenson, M. L., Ostrander, A. G., Norasi, H., & Dorneich, M. C. (2019). Shoulder muscular fatigue from static posture concurrently reduces cognitive attentional resources. *Human factors*, 0018720819852509.

Sun, Y., Nimbarte, A. D., & Motabar, H. (2017). Physical Risk Factors Associated with the Work-Related Neck/Cervical Musculoskeletal Disorders: *A Review. Industrial and Systems Engineering Review*, 5(1), 44-60.

Taherdoost, H. (2021). Data collection Methods and Tools for Research; A Step-by-Step Guide to choose Data Collection Technique. . . *ResearchGate*. https://www.researchgate.net/publication/359596426_Data_Collection_Methods_and_Tools_for_Research_A_Step-by-Step_Guide_to_Choose_Data_Collection_Technique_for_Academic_and_Business_Research_Projects

Tan, A. H. (2022). Glove Manufacturing: Opportunities and Challenges in control Engineering. IFAC-PapersOnLine, 55(1), 872–877. https://doi.org/10.1016/j.ifacol.2022.04.143

Te-Hsin,P&Kleiner,B.H. (2001). New developments concerning the occupational safety and health act. *Journal of Managerial Law.* Volume 43, No ½,138-146

The Star Special. (2024, February 27). Export Excellence Awards 2023. The Star Special. https://cdn.thestar.com.my/Components/Flyin/PDF/EEA2023.pdf

Tyrovolas, S., Moneta, V., Vázquez, I. G., Koyanagi, A., Abduljabbar, A. S., & Haro, J. M. (2020). Mental Disorders, Musculoskeletal Disorders and Income-Driven Patterns: Evidence from the Global Burden of Disease Study 2017. Journal of Clinical Medicine, 9(7), 2189. https://doi.org/10.3390/jcm9072189

Van Eerd D et al (2010) Process and implementation of participatory ergonomic interventions: a systematic review. Ergonomics 53(10):1153–1166

Varghese, A., & Panicker, V. V. (2022). Effect of MSDs and scope of ergonomic interventions among rubber processing workers: a systematic review. PubMed, 113(4), e2022032. https://doi.org/10.23749/mdl.v113i4.12826

Vasileiou, K., Barnett, J., Thorpe, S., & Young, T. (2018). Characterising and justifying sample size sufficiency in interview-based studies: systematic analysis of qualitative health research over a 15-year period. BMC Medical Research Methodology, 18(1). https://doi.org/10.1186/s12874-018-0594-7

Wang, P., Yang, C., Huang, Y., & Cheng, Y. (2022). A case study of Ergonomics Prevention program in a machine manufacture industry. Rsf Conference

Proceeding Series. Engineering and Technology, 2(1), 18–22. https://doi.org/10.31098/cset.v2i1.538

Weston, E. B., Hassett, A. L., Khan, S. N., Weaver, T. E., & Marras, W. S. (2022). The potential relationship between a cognitive dissonance state and musculoskeletal injury: A systematic review. Human Factors, 66(4), 1152–1169. https://doi.org/10.1177/00187208221120459

Wilkerson, A. H., Abutalib, N., McFadden, N. T., Bhochhibhoya, S., Dragicevic, A., Salous, B. R., & Nahar, V. K. (2023). A Social Cognitive Assessment of Workplace Sedentary Behavior among a Sample of University Employees. CEST. https://doi.org/10.20944/preprints202304.1026.v1

Work-Related Musculoskeletal Disorders & Ergonomics | Workplace Health Strategies by condition | Workplace Health Promotion | CDC. (n.d.). https://www.cdc.gov/workplacehealthpromotion/health-strategies/musculoskeletal-disorders/index.html

Wu, D., Wong, P., Guo, C., Tam, L., & Gu, J. (2021). Pattern and trend of five major musculoskeletal disorders in China from 1990 to 2017: findings from the Global Burden of Disease Study 2017. BMC Medicine, 19(1). https://doi.org/10.1186/s12916-021-01905-w

Yang, F., Di, N., Guo, W., Ding, W., Jia, N., Zhang, H., Li, D., Wang, D., Wang, R., Zhang, D., Liu, Y., Shen, B., Wang, Z., & Yin, Y. (2023). The prevalence and risk factors of work related musculoskeletal disorders among electronics manufacturing workers: a cross-sectional analytical study in China. BMC Public Health, 23(1). https://doi.org/10.1186/s12889-022-14952-6

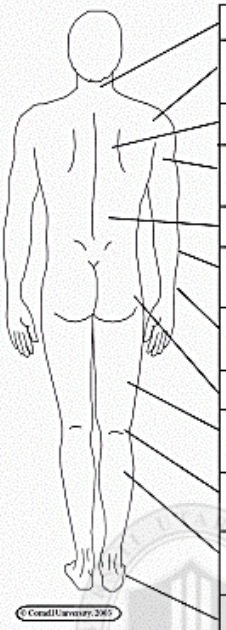
Yılmaz, M. (2023). Analysis of Working Postures in Rubber Manufacturing Industry by using OWAS and RULA Methods. Interna*tional Journal of Pioneering Technology and Engineering (Online),* 2(01), 103–112. https://doi.org/10.56158/jpte.2023.39.2.01

Yusof, N. A., & Shalahim, N. N. S. M. (2020). INVESTIGATION OF ERGONOMIC RISK FACTORS AMONG MALE WORKERS IN a MEDICAL MANUFACTURING COMPANY IN NORTHERN MALAYSIA. Malaysian Journal of Public Health Medicine, 20(Special1), 167–175. https://doi.org/10.37268/mjphm/vol.20/no.special1/art.697

Zare, M., Black, N., Sagot, J., Hunault, G., & Roquelaure, Y. (2020). Ergonomics interventions to reduce musculoskeletal risk factors in a truck manufacturing plant. *International Journal of Industrial Ergonomics*, 75, 102896. https://doi.org/10.1016/j.ergon.2019.102896

Appendix A : Cornel Musculoskeletal Disorder

The diagram below shows the approximate position of the body parts referred to in the questionnaire. Please answer by marking the appropriate box.



	During the last work week how often did you experience ache, pain, discomfort in:					If you experienced ache, pain, discomfort, how uncomfortable was this?			If you experienced ache, pain, discomfort, did this interfere with your ability to work?		
	Never	1-2 times last week	3-4 times last week	Once every day	Several times every day	Slightly uncomfortable	Moderately uncomfortable	Very uncomfortable	Not at all	Slightly interfered	Substantially interfered
Neck	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Shoulder (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Shoulder (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Upper Back	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Upper Arm (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Upper Arm (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lower Back	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Forearm (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Forearm (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wrist (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wrist (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Hip/Buttocks	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Thigh (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Thigh (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Knee (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Knee (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lower Leg (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lower Leg (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Foot (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Foot (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Appendix B : Checklist For Awkward Posture

Body Part	Physical Risk Factor	Maximum Exposure Duration (continuously or cumulatively)	Illustration	Please tick (/)	
				Yes	No
Shoulders	Working with hand above the head OR the elbow above the shoulder	More than 2 hours per day			
	Working with shoulder raised	More than 2 hours per day			
	Work repetitively by raising the hand above the head OR the elbow above the shoulder more than once per minute	More than 2 hours per day			
Head	Working with head bent downwards more than 45 degrees	More than 2 hours per day			

Source: Guidelines on Ergonomic Risk Assessment at Workplace, 2017

Appendix B: Continued

Body Part	Physical Risk Factor	Maximum Exposure Duration (continuously or cumulatively)	Illustration	Please tick (/)	
				Yes	No
	Working with head bent backwards	More than 2 hours per day			
	Working with head bent sideways	More than 2 hours per day	 		
Back	Working with back bent forward more than 30 degrees OR bent sideways	More than 2 hours per day			
	Working with body twisted	More than 2 hours per day			

Source: Guidelines on Ergonomic Risk Assessment at Workplace, 2017

Appendix B: Continued

Body Part	Physical Risk Factor	Maximum Exposure Duration (continuously or cumulatively)	Illustration	Please tick (/)	
				Yes	No
Hand/ Elbow/ Wrist	Working with wrist flexion OR extension OR radial deviation more than 15 degrees	More than 2 hours per day	 flexion  extension  deviation		
	Working with arm abducted sideways	More than 4 hours per day			
	Working with arm extended forward more than 45 degrees OR arm extended backward more than 20 degrees.	More than 2 hours per day	 		

Source: Guidelines on Ergonomic Risk Assessment at Workplace, 2017

Appendix B: Continued

Body Part	Physical Risk Factor	Maximum Exposure Duration (continuously or cumulatively)	Illustration	Please tick (/)	
				Yes	No
Leg/ Knees	Work in a squat position.	More than 2 hours per day			
	Work in a kneeling position	More than 2 hours per day			
Sub Total (Number of tick(s))					

Appendix C : Checklist for Static and Sustained Work Posture

Body Part	Physical Risk Factor	Maximum Exposure Duration	Illustration	Please tick (/)	
				Yes	No
Trunk/Head/ Neck/Arm/ Wrist	Work in a static awkward position as in Table 3.1	Duration as per Table 3.1			
Leg/Knees	Work in a standing position with minimal leg movement.	More than 2 hours continuously			
	Work in seated position with minimal movement.	More than 30 minutes continuously			
Sub Total (Number of tick(s))					

Appendix D : Recommended weight limit for lifting and/or lowering

Working Height (where force is applied)	Recommended weight limit (male or female)	Current weight handled	Exceed limit?	
			Yes	No
Between floor to mid-lower leg				
Between mid-lower leg to knuckle				
Between knuckle height and elbow				
Between elbow and shoulder				
Above the shoulder				

Source: Guidelines on Ergonomic Risk Assessment at Workplace, 2017

Appendix E : Recommended weight limit for lifting and/or lowering, with repetitive operation

If employee repeats operations	Weight limit * should be reduced by
Once or twice per minutes	30%
Five to eight times per minute	50%
More than 12 times per minute	80%

Source: Guidelines on Ergonomic Risk Assessment at Workplace, 2017

Appendix F : Summary table for single manual handling (forceful exertion)

Activity (where applicable)	Recommended weight limit	Exceed limit?	
		Yes	No
Lifting and lowering only; or	based on Figure 3.1 and Table 3.3		
Repetitive lifting and lowering; or	based on Figure 3.1 and Table 3.4		
Twisted body posture while lifting and lowering; or	based on Figure 3.1 and Table 3.5		
Repetitive lifting and lowering with twisted body posture; or	based on Figure 3.1, Table 3.4 and Table 3.5		
Pushing and pulling; or	based on Table 3.6		
Handling in seated position; or	based on Figure 3.2		
Carrying	based on Table 3.7		

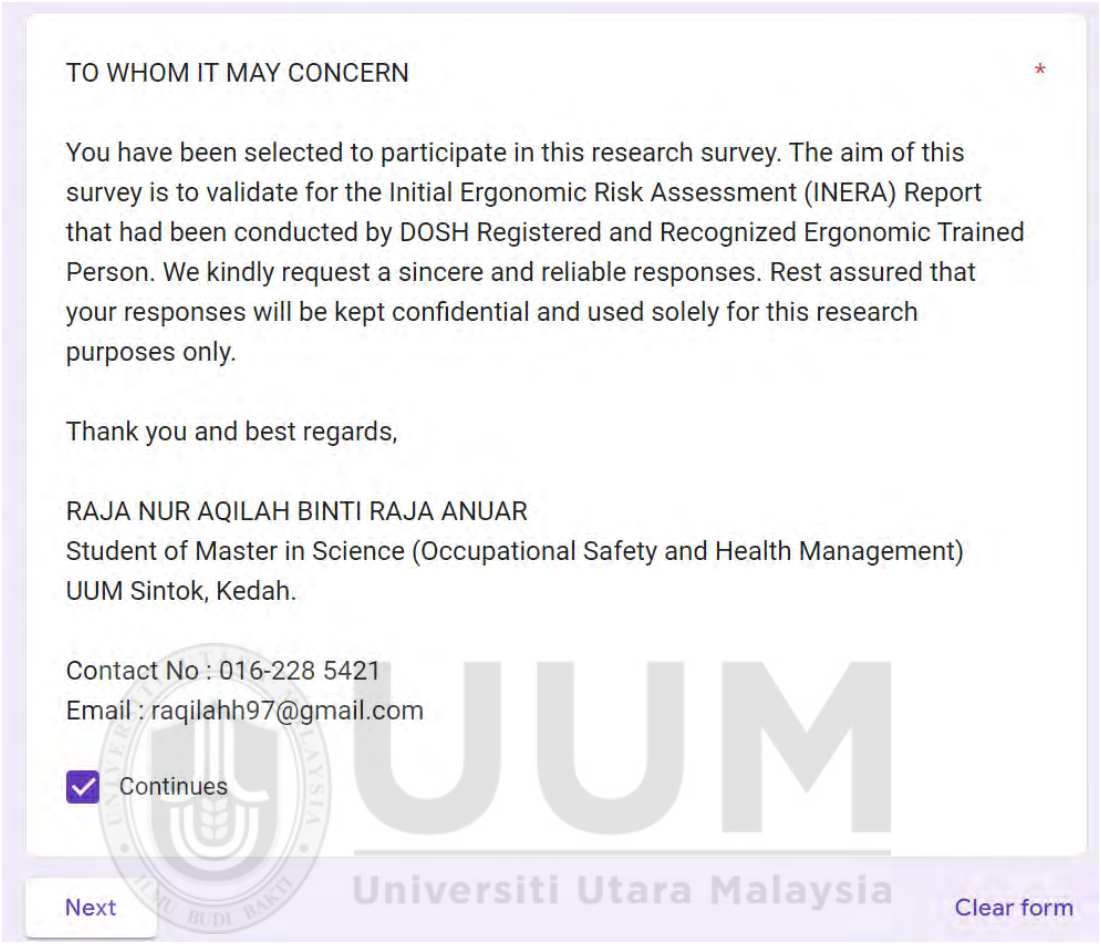
Source: Guidelines on Ergonomic Risk Assessment at Workplace, 2017

Appendix G : Repetitive motion checklist

Body Part	Physical Risk Factor	Max. Exposure Duration	Please tick (/)	
			Yes	No
Neck, shoulders, elbows, wrists, hands, knee	Work involving repetitive sequence of movement more than twice per minute	More than 3 hours on a "normal" workday OR More than 1 hour continuously without a break		
	Work involving intensive use of the fingers, hands or wrist or work involving intensive data entry (key-in)			
	Work involving repetitive shoulder/arm movement with some pauses OR continuous shoulder/arm movement			
	Work using the heel/base of palm as a "hammer" more than once per minute	More than 2 hours per day		
	Work using the knee as a "hammer" more than once per minute.	More than 2 hours per day		
Sub Total (Number of tick(s))				

Source: Guidelines on Ergonomic Risk Assessment at Workplace, 2017

Appendix H : Review on Initial Ergonomic Risk Assessment (INERA) Report for Rubber Based Manufacturing Industry – Data Reliability Purposes.



TO WHOM IT MAY CONCERN *

You have been selected to participate in this research survey. The aim of this survey is to validate for the Initial Ergonomic Risk Assessment (INERA) Report that had been conducted by DOSH Registered and Recognized Ergonomic Trained Person. We kindly request a sincere and reliable responses. Rest assured that your responses will be kept confidential and used solely for this research purposes only.

Thank you and best regards,

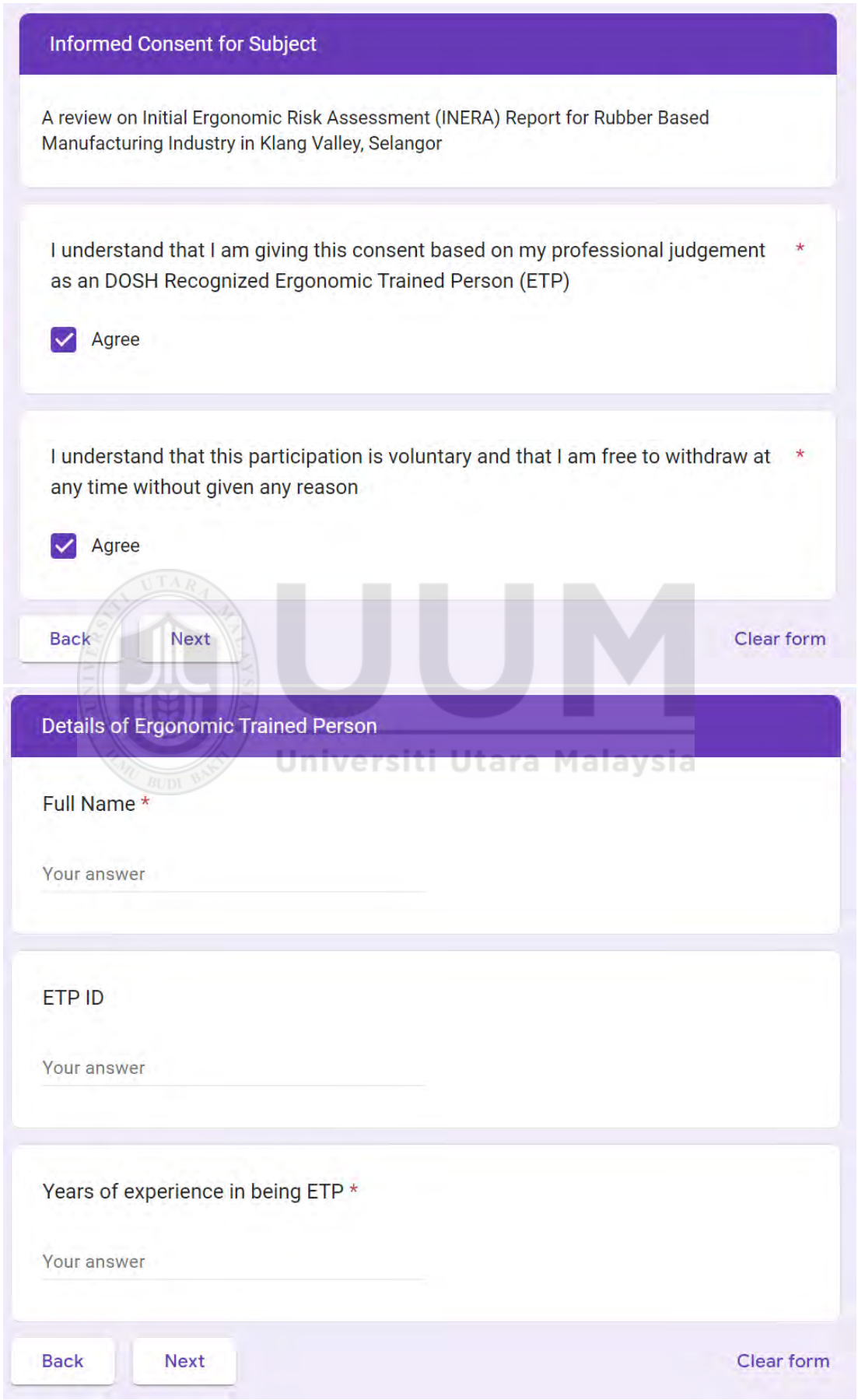
RAJA NUR AQILAH BINTI RAJA ANUAR
Student of Master in Science (Occupational Safety and Health Management)
UUM Sintok, Kedah.

Contact No : 016-228 5421
Email : raqilahh97@gmail.com

☑ Continues

Next Clear form

Appendix H : Continues



Informed Consent for Subject

A review on Initial Ergonomic Risk Assessment (INERA) Report for Rubber Based Manufacturing Industry in Klang Valley, Selangor

I understand that I am giving this consent based on my professional judgement as an DOSH Recognized Ergonomic Trained Person (ETP) *

☑ Agree

I understand that this participation is voluntary and that I am free to withdraw at any time without given any reason *

☑ Agree

Back Next Clear form

Details of Ergonomic Trained Person

Full Name *

Your answer

ETP ID

Your answer

Years of experience in being ETP *

Your answer

Back Next Clear form

Appendix H : Continues

Initial Ergonomic Risk Assessment (INERA) Report

Kindly please give scores based on the INERA Report conducted

The checklist for awkward posture is done accurately *

	1	2	3	4	5	
Not Accurate	○	○	○	○	○	Accurate

Any feedback from the awkward posture checklist?

Your answer

The checklist for static posture is done accurately *

	1	2	3	4	5	
Not Accurate	○	○	○	○	○	Accurate

Any feedback from the checklist of static posture score ?

Your answer

The recommended weight limit for lifting/lowering is calculated correctly *

- ○ Yes
- ○ No

Appendix H : Continues

Any feedback from the recommended weight limit calculation?

Your answer

The summary table for single manual handling is tick accurately *

	1	2	3	4	5	
Not accurate	○	○	○	○	○	Accurate

Any feedback from the table for manual handling score?

Your answer

The checklist for repetitive motion is done accurately *

	1	2	3	4	5	
Not accurate	○	○	○	○	○	Accurate

Any feedback from the repetitive motion score?

Your answer

The recommendation from the result are sufficient *

	1	2	3	4	5	
Not sufficient	○	○	○	○	○	Sufficient

Appendix H : Continues