



Ergonomic Analysis of Physical Workload on Work Accidents and Increased Work Productivity

Gempur Santoso^{1*}, Asri Dwi Puspita², Dini Retnowati³

¹Professor of Ergonomics and Occupational Health Safety, Industrial Engineering, Faculty of Engineering, Maarif Hasyim Latif Sidoarjo University

²Lecturer in Industrial Engineering, Faculty of Engineering, Maarif Hasyim Latif Sidoarjo University

³Lecturer in Industrial Engineering, Faculty of Engineering, Maarif Hasyim Latif Sidoarjo University

ABSTRACT

This paper analyzes ergonomics and physical workload that is not excessive to avoid work accidents and increase work productivity. This is to find out the layout in working ergonomically which has an impact on reducing work accidents, so that labor productivity will increase. This writing, data collection from various research results as literature. Then, analysis and discussion were carried out. Therefore this scientific work uses descriptive analysis. Conclusion: 1) The design of an ergonomic approach to overcome excessive workload, namely: creating a layout with a short work flow, and work equipment that is adapted to the user's anthropometry. This musculoskeletal complaints, fatigue, workload, risk of injury/accident will decrease, and productivity will increase. 2) Workload will not increase if work is adjusted to threshold values, tools adjusted to employee anthropometry, appropriate work positions, and sensory sensitivity. With an excessive workload will avoid accidents. Suggestion: It is better if the company arranges the factory with an ergonomic approach, namely: the layout of the production process is close (short distance), the equipment is adjusted to employee anthropometry, works according to the threshold value in the environment, a physiological work position, and employees who have sensitive senses.

ARTICLE'S INFO

Article No.: 032725051

Type: Research

Full Text: [PDF](#), [PHP](#), [MP3](#)

DOI: [10.15580/qjemps.2025.1.032725051](https://doi.org/10.15580/qjemps.2025.1.032725051)

Accepted: 02/04/2025

Published: 30/07/2025

*Corresponding Author

Gempur Santoso

E-mail: gempur_santoso@dosen.umaha.ac.id

Keywords: Ergonomics, Physical Workload, Work Accidents, Work Productivity

1. INTRODUCTION

Ergonomics means balanced, harmonious and appropriate between work factors and worker factors. The scope of this work factor is the work environment, work tools and materials used. Ergonomic balance is created through a match between work demands and work capacity. Are high/heavy task demands a workload and will cause work accidents? It needs to be analyzed and discussed ergonomically.

Workload greatly affects the occurrence of accidents. As the results of the research by Yohanes Kurniawan, et al (2018) stated that "a sample of 42 respondents to this study were loading and unloading workers in the fertilizer removal section at the Fertilizer Packaging Unit at Tanjung Emas Port, Semarang. Most of the respondents have a heavy workload that is as much as 69%. Respondents who experienced work accidents were as much as 81%.

In line with that, the high workload on health care workers will cause work accidents. As according to Dewi Sofiantika (2020) states that "There were 44 respondents (80%) with a high level of workload. There were 29 respondents (52.72%) who had a nurse's work accident.

On the other hand, that the workload is not boring. Saturation occurs due to other factors. As Moch. Zulfikar Afifuddin Rizqiansyah (2017) stated in the conclusion of the research results that "physical workload and workload cannot predict the occurrence of burnout in employees so it is possible that there are many other factors that can influence the occurrence of burnout". In addition, work shifts also have no effect on work accidents. As Yuliana Patrisia¹ (2018) states that "work shifts do not affect occupational health and safety".

Workload and work safety greatly affect work satisfaction Oktavina Kristin Handayani (2020) research results state that "the factors that most influence job satisfaction in companies are workload and occupational safety and health (K3)". Because job satisfaction will increase work productivity. As the results of Sulaiman's research (2020) show that "job satisfaction has a positive and significant effect on employee work productivity in the Mattoangin convection and printing business in the city of Makassar".

Therefore it is necessary to do an ergonomic work rhythm. This means that the workload is in accordance with ergonomics and threshold conditions, and there are no work accidents, work in a satisfied state so that work productivity is optimal.

2. METHODOLOGY

Analyzing about ergonomic arrangement and physical workload that is not excessive will prevent work accidents and increase work productivity, needs to be done. This is to find out the layout in working ergonomically, so that work accidents are reduced. Thus, labor productivity will increase. This writing, data collection from various research results as literature.

Then, analysis and discussion were carried out. Therefore this scientific work uses descriptive analysis.

3. ANALYSIS AND DISCUSSION

3.1. Ergonomics, Physical Workload and Work Productivity

According to StaffAny (2022) "Workload is the amount of work that must be done and completed by an employee. Workload can be classified into two forms, namely quantitative (amount of work to be done) or qualitative (level of work difficulty). Workload has an influence on the productivity and quality of work produced by employees.

Physical workload is very different from mental workload, also as Putrama Aulia Al-Khairi (2021) says that "physical work is work that requires the physical energy of human muscles as a source of energy (power), while physical workload is a burden that a person receives. employees in a job related to the physiological condition of the body.

Therefore, to reduce the physical workload, it is necessary to apply ergonomics in the industry. As Torik Husein 2009 says that "the application of ergonomics to improve work systems is carried out by redesigning (1) Facility layout. Based on the observations and analysis carried out, the current facility layout is not good and requires improvement because it makes moving materials longer and more difficult; (2) Work equipment that requires repair is a work chair and Jig (dos placement tool). Work equipment that is now uncomfortable to use and has the potential to cause health problems for workers, this is based on complaints felt by workers that they often feel pain in the arms, waist, calves, hands and shoulders. Basically, improving work ergonomics is: a layout with a short work flow, and work equipment that is adapted to the user's anthropometry.

With a high workload then the work system is arranged ergonomically which will reduce and eliminate complaints of pain in the musculoskeletal, not easily tired, the workload becomes light making it comfortable, not causing harm, improving work productivity, and improving worker income. That is, as Hari Purnomo (2007) in the results of the study showed that a work system with a total ergonomics approach can: (a) reduce workers' musculoskeletal complaints by 87.8%; (b) reduce worker fatigue by 77.5%; (c) reducing the workload of workers by 21.55 beats/minute or by 21.69%; (d) reduce the risk of injury at work by 10.65% ; (e) increasing worker productivity by 59.49%; and (f) increasing employee income by 23.81% and increasing company income by 76.19%.

Based on the discussion above, it can be concluded that workload is related to the amount worked and the difficulty of the work. To overcome the physical workload, it is necessary to design with an ergonomic approach, namely creating a layout with a short work flow, and work equipment that is adapted to the user's anthropometry. Thus musculoskeletal

complaints, fatigue, workload, risk of injury/accident will decrease, and productivity will increase.

3.2. Workload and Work Accidents

According to H.W. Administrator wrote Heinrich (2019) that "the most common cause of work accidents is unsafe behavior (human error) of 88%. Physical as well as psychological imbalance, physical stress, mental stress, lack of knowledge, lack of skills, and decreased work motivation. It's all elements of the human factor that causes accidents.

Specifically regarding human-caused accidents, the focus is on the element of physical imbalance, that the body's weight or strength is not in accordance with its work duties. For example, the workload is heavier than the work capacity. There will be an accident if the threshold value (NAV) is not adjusted. If imposed on excessive load, there will be negative effects, accidents. As according to Alvina, et al (2017) concluded that "excessive workload at the hospital can cause work stress which can then result in work accidents". Even work will be satisfied if the workload is not excessive, as Oktavina Kristin Handayani (2020) concluded from the research results "the factors that most influence job satisfaction in companies are workload and occupational safety and health (K3)".

Also, non-ergonomic working range will cause accidents. This is related to leg reach, hand reach, and sight range. If work cannot be afforded, it is certain that an accident will occur. After improving the adjustment of employee range with equipment, the risk of accidents decreases. As Gede Ngurah Surya Kencana (2022) results of his research that "the risk of injury at work is either illness in certain parts of the body or accidents. After the repairs were carried out, the risk level was reduced to moderate and it was proven by employees who felt more comfortable at work and reduced complaints of pain in workers.

Body position at work, it is important. Body position is closely related to body shape. If the position makes the body have a body moment, it will obviously make you tired quickly. In addition, the position of the body when working is also related to skeletal muscles. If the position of the body makes it work, the ends of the muscles move more (large) the base of the muscles, it will tire easily. It should be the other way around, that is, the base of the muscle moves the end of the muscle so it doesn't get tired easily. The position of the body at work, makes it easy to get tired. Being tired and continuing to work is very close to an accident.

Inappropriate or non-ergonomic work positions will experience fatigue, as the results of Herlina S. Sunuh's research (2021) stated that "60 workers (100%) experience unsuitable work positions, 5 workers experience normal fatigue (8.3%), fatigue light as many as 47 workers (76.7%), and moderate fatigue as many as 8 workers (15.0%).

Sensitivity of the body or sensitivity of the senses. On the five senses: smell, hear, see, taste, and feel. All of that must have sensitivity in work. For example: must be able to distinguish various odors. If

there is a smell of burning wires, of course you must know and the source must be sought, to be repaired. If you don't know, you're not sensitive, there's a smell of electrical wiring. Will just stay put, left alone, obviously there will be fires and other accidents.

Physically disabled, of course they must still be allowed to work, if they use a tool to overcome their disability or also modify their work tools, so they can easily do their job. For example: the disabled don't have legs, of course you can work as a rickshaw. This can be done by modifying the pedicab driver's seat, and modifying the pedicab not to use human leg power, for example replacing it with a motorized engine. If you are forced to be a rickshaw, you are not given any modified tools. Obviously will not be able to carry out his work or wretched. Also temporary physical disability. It is better if the temporary disability is cured first. After recovering from his disability, then work again. If you are temporarily disabled, you are forced to work, the disability will get worse and become a source of accidents.

Based on the discussion above, that the workload will not be high if work is adjusted to threshold values, tools are adjusted to employee anthropometry, appropriate work positions, and sensory sensitivity. With a workload that is not excessive, accidents will be avoided.

4. CONCLUSIONS AND SUGGESTIONS

4.1. Conclusion

- a. To overcome the physical workload, it is necessary to design with an ergonomic approach, namely creating a layout with a short work flow, and work equipment that is adapted to the user's anthropometry. Thus musculoskeletal complaints, fatigue, workload, risk of injury/accident will decrease, and productivity will increase.
- b. The workload will not be high if work is adjusted to threshold values, tools are adjusted to employee anthropometry, appropriate work positions, and sensory sensitivity. With an excessive workload will avoid accidents.

4.2. Suggestion

Companies should carry out factory arrangements with an ergonomic approach, namely: the layout of the production process that is close (short distance), equipment adjusted to employee anthropometry, working according to environmental threshold values, physiological work positions, and employees who have sensitive senses.

BIBLIOGRAPHY

Alvina C B B S, Beta Ahlam Gizela, Idha Arfianti Wiraagni, 2017, Hubungan Antara Beban Kerja dan Angka Kecelakaan Kerja di RSUP Dr

- Soeradji Tirtonegoro, Perpustakaan Universitas Gajah Mada, Bulaksumur, Yogyakarta.
- Administrator, 2019, K3 Dan Pengaruhnya Terhadap Produktivitas Kerja Perusahaan, Balai Diklat Industri, Yogyakarta.
- Dewi Sofiantika, Rakhmat Susilo, 2020, Hubungan beban kerja dan lingkungan kerja dengan kejadian kecelakaan kerja pada perawat ruang rawat inap di RSUD Banyumas, *Jurnal Keperawatan Muhammadiyah*, ISSN: 2541-2396, E-ISSN: 2597-7539, Banyumas.
- Gede Ngurah Surya Kencana, P. Vitasari, Soemanto, 2022, Analisis Resiko Kecelakaan Kerja Pada Karyawan Dengan Metode Rapid Upper Limb Assesment Pada Perusahaan Packing Air Minum Dalam Kemasan, *Jurnal Valtech (Jurnal Mahasiswa Teknik Industri)* Vol. 5 No. 1 (2022), E-ISSN : 2614-8382, Program Studi Teknik Industri, Fakultas Teknologi Industri, Institut Teknologi Nasional, Malang.
- Hari Purnomo, Adnyana Manuaba, Nyoman Adiputra, 2007, Sistem Kerja Dengan Pendekatan Ergonomi Total Mengurangi Keluhan Muskuloskeletal, Kelelahan Dan Beban Kerja Serta Meningkatkan Produktivitas Pekerja Industri Gerabah Di Kasongan, Bantul, Vol. 1, No. 3 Desember 2007 /ISSN 2302-2906. Indonesian Journal of Biomedical Science.
- Herlina S. Sunuh, Saharudin, Herdi, 2021, Posisi Kerja dan Kelelahan pada Pekerja Rotan di CV. Fajar Baru Kecamatan Palu Utara, Banua: *Jurnal Kesehatan Lingkungan* e-ISSN 2797-8184, p-ISSN 2797-8176 <http://jurnal.poltekkespalu.ac.id/index.php/bjkl/> Volume 1 Nomor 1, Mei 2021, Jurusan Kesehatan Lingkungan, Poltekkes Kemenkes Palu, Indonesia
- Ilham Frandinata Maizir, 2021, Analisis Beban Kerja Fisik Karyawan Warehouse PT. XYZ Berdasarkan Perubahan Fungsi Tubuh (Denyut Nadi), Seminar Nasional Teknik Industri Universitas Gajah Mada Yogyakarta, 23 September 2021, Fakultas Teknologi Industri Universitas Islam Indonesia Yogyakarta.
- Moch. Zulfiqar Afifuddin Rizqiansyah, 2017, Hubungan Antara Beban Kerja Fisik Dan Beban Kerja Mental Berbasis Ergonomi Terhadap Tingkat Kejenuhan Kerja Pada Karyawan Pt Jasa Marga (Persero) Tbk Cabang Surabaya Gempol, *Jurnal Sains Psikologi*, Jilid 6, Nomor 1, Maret 2017, Fakultas Pendidikan Psikologi Universitas Negeri Malang.
- Oktavina Kristin Handayani, 2020, Pengaruh Beban Kerja, Stres Kerja, Keselamatan Dan Kesehatan Kerja (K3) Terhadap Kepuasan Kerja Karyawan, Institut Bisnis dan Informatika, Jakarta.
- Oktavina Kristin Handayani, 2020, Pengaruh beban kerja, stres kerja, keselamatan dan kesehatan kerja (K3) terhadap kepuasan kerja karyawan PT. xyz, Institut Bisnis dan Informatika Kwik Kian Gie, Jakarta.
- StaffAny, 2022, Pengaruh Beban Kerja Terhadap Kinerja Karyawan, 2022 November 7, <https://www.staffany.id/>
- Sulaiman, Abdul Safrin Daeng Talli, 2020, Pengaruh Kepuasan Kerja Terhadap Produktivitas Karyawan Pada Usaha Konveksi dan Percetakan Mattoangin di Kota Makassar, *Economy Deposit Journal* Volume 2 No 2, Desember 2020, Universitas Indonesia Timur Makassar
- Torik Husein, M. Kholil, Ari Sarsono, 2009, Perancangan Sistem Kerja Ergonomis Untuk Mengurangi Tingkat Kelelahan, *INASEA*, Vol. 10 No.1, April 2009: 45-58, Jurusan Teknik Industri, Universitas Mercu Buana, Jakarta Barat
- Yohanes Kurniawan, Bina Kurniawan, Ekawati, 2018, Hubungan Pengetahuan, Kelelahan, Beban Kerja Fisik, Postur Tubuh Saat Bekerja, Dan Sikap Penggunaan Apd Dengan Kejadian Kecelakaan Kerja (Studi Pada Aktivitas Pengangkatan Manual Di Unit Pengantongan Pupuk Pelabuhan Tanjung Emas Semarang), *JURNAL KESEHATAN MASYARAKAT (e-Journal)* Volume 6, Nomor 4, Agustus 2018 (ISSN: 2356-3346), Bagian Keselamatan dan Kesehatan Kerja, Fakultas Kesehatan Masyarakat Universitas Diponegoro, Semarang.
- Yuliana Patrisia, 2018, Pengaruh Beban Kerja, Kelelahan Kerja Terhadap Kesehatan dan Keselamatan Kerja (K3), *Jurnal Psikoborneo*, Vol 6, No 1, 2018: 142-149 ISSN: 2477-2666/E-ISSN: 2477-2674, Program Studi Psikologi Fakultas Ilmu Sosial dan Ilmu Politik Universitas Mulawarman Samarinda