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Masters Program in Public Health, Universitas Sebelas Maret

Meta-Analysis

Effects of Occupational Stress and Frequency of Lifting Heavy Loads on Low Back Pain in Health Workers: A Meta Analysis

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ABSTRACT

Background: Health workers have a high risk for experiencing symptoms of disorders of the musculoskeletal system such as pain, injury, trauma, and other disorders. According to the World Health Organization (WHO), work-related musculoskeletal disorders or commonly called work-related musculoskeletal disorders (WRMDs) are injuries that include various inflammatory disorders or degenerative diseases associated with pain or functional disorders in the body.
Subjects and Method: This study is a systematic review and meta-analysis with the following PICO, Population: Health workers. Intervention: High stress and high frequency of heavy lifting. Comparison: Low stress and low frequency of weight lifting. Outcome: Back pain. The articles used in this study were obtained from three databases, namely Google Scholar, Pubmed, and Science Direct. Keywords to search for articles "low back pain" "risk factors" "determinants" "predictors" AND "health workers" The articles included were full-text English with a cohort and cross-sectional study design from 2016 to 2021 and reported the adjusted odds ratio (aOR) in the multivariate analysis. The selection of articles was done by using PRISMA flow diagram. Articles were analyzed using the Review Manager 5.3 application.
Results: A total of 5 cohort and 10 cross-sectional studies, ten articles included nurses as research respondents, four articles included overall medical personnel, and one article included ambulance workers. Research locations are in Denmark, Saudi Arabia, China, Japan, Malaysia, Iran, Brazil Italy, Australia, Yemen, Estonia, and Ethiopia with medical workers who have low levels of job stress (aOR= 2.52; 95% CI= 2.15 to 2.96; p< 0.001) and it can be concluded that medical workers with frequent heavy lifting have a risk of experiencing back pain by 2.01 times compared to medical workers with infrequent weight lifting frequency (aOR= 2.01; 95% CI 1.23 to 3.18; p = 0.003).
Conclusion: Medical workers with high levels of job stress and frequent heavy lifting are at risk for back pain.

Keywords: back pain, stress, weight lifting.

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BACKGROUND

Health workers have a high risk of experiencing symptoms of disorders of the musculoskeletal system such as pain, injury, trauma, and other disorders (National Institute for Occupational Health and Safety, 2011).

According to the World Health Organization (WHO), work-related musculoskeletal disorders or commonly called work-related musculoskeletal disorders (WRMDs) are injuries that include various inflammatory disorders or degenerative diseases that are associated with pain or functional disorders in the body (WHO, 1985; Milhem). et al., 2016). Work-related musculoskeletal disorders (WMSD) refer to a variety of conditions caused by inflammation or degeneration of tendons, nerves, ligaments, muscles, and periarticular structures in different places (fingers, wrists, arms, shoulders, and cervical region) of the spinal cord, upper limbs and neck (da Costa and Vieira, 2010).

WMSD is the main cause of absence of health workers at work, this of course greatly affects their quality of life and professional performance. According to the Bureau of Labor Statistics, WMSD is listed as one of the top threats to healthcare workers. Several occupational factors such as workload, work posture, and duration of work were reported as influencing the prevalence of WMSDs (Dick et al., 2015; Bozkurt et al., 2016). The physical demands of work as a nurse, namely patient care, are thought to be the main factor that triggers the high number of musculoskeletal symptoms and disorders of the lower back and other body parts (Tullar et al., 2010).

In general, WRMDs are considered to cause lost or reduced working time, work restrictions, loss of professional career disruption, loss of consciousness, and even death. In addition, these disorders are associated with economic and social burdens, which will ultimately have an impact on quality of life (Holder et al., 1999; Salik and Ozcan, 2004; Rahimi et al., 2018).

Previous research has shown that WMSDs are directly caused by physically demanding jobs and strenuous working conditions, such as lifting or carrying heavy loads, performing too many repetitive motions, being in tiring positions or in uncomfortable positions for a long time (and for long periods of time). Costa & Vieira, 2010; Ngan et al., 2010; Long et al., 2012). Locateli (2016) found a solution that a better distribution of weight lifting on the body could be beneficial in the prevention of WMSDs, especially for low back pain.

In addition, MSD was also found to be associated with psychologically stressful work, namely with psychosocial and stressful work factors such as time pressure, low job control, little social support or supervisors, imbalance of effort with rewards, and conflict in the work environment (Hämmig, 2017; Amin et al., 2018; Bazazan et al., 2019).

SUBJECTS AND METHOD

1. Study Design

This study was a systematic review and meta-analysis. The articles used in this study were obtained from several databases, namely Google Scholar, Pubmed, and Science Direct between 2016 and 2021. The selection of articles was carried out using PRISMA flow diagrams. The keywords to search for articles are as follows: "low back pain" "risk factors" "determinants" "predictors" AND "health workers".

2. Inclusion Criteria

The inclusion criteria in this study article were: English and Indonesian articles with observational design. The analysis used was multivariate with an adjusted odd ratio association measure. The study subjects were medical officers (surgical nurses, radiographers, sonographers, surgeons, obstetricians and gynecologists, etc.). Study subjects experience symptoms of back pain due to work undertaken.

3. Exclusion Criteria

Exclusion criteria in this study article were: articles published in languages other than English, statistical results reported in the form of bivariate analysis, articles before 2016.

4. Operational Definition of Variables

The search for articles was carried out by considering the eligibility criteria determined using the PICO model. Population: Health workers. Intervention: High stress and high frequency of heavy lifting. Comparison: Low stress and low frequency of weight lifting. Outcome: Back pain.

Back Pain defined as a condition where there is dysfunction in the ligaments, muscles, nerves, joints and tendons in the spine that causes pain, Measuring Instruments: questionnaires or medical data of respondents describing conditions of back pain that are currently or have been experienced, Scale: categorical-dichotomous

Job stress on back pain defined as the level of stress of medical personnel on their daily workload, Measuring Instrument: a questionnaire that describes the level of stress of medical personnel on their daily workload, Scale: categorical-dichotomous.

Frequency of weight lifting against back pain

defined as the intensity level of the activity of lifting or transferring patients by medical personnel, Measuring Instrument: a questionnaire that asks the frequency of medical personnel carrying out patient transfer activities or lifting patients, Scale: categorical-dichotomous).

5. Study Instruments

This study was guided by PRISMA flow diagrams and quality assessment using Critical Appraisal Skills Program (CASP, 2018).

6. Data Analysis

The data in the study were analyzed using the Review Manager application (RevMan 5.3). Forest plots and funnel plots were used to measure the relationship and heterogeneity of the data. The fixed effect model is used for homogeneous data, while the random effect model is used for heterogeneous data across studies.

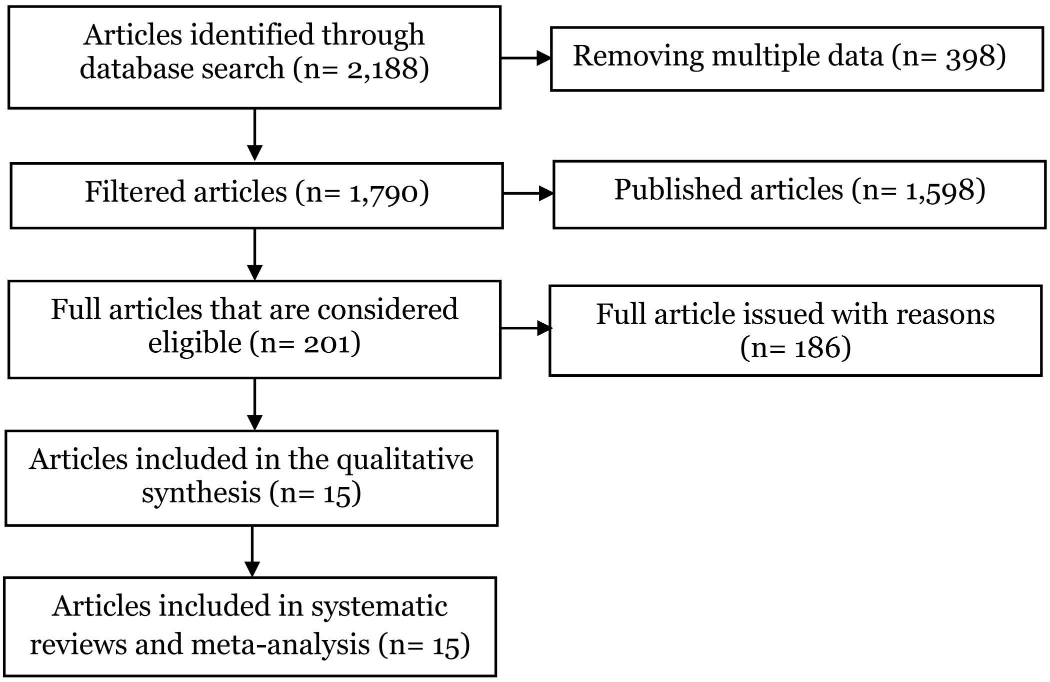

Figure 1. PRISMA Flowchart

Table 1. Assessment of study quality published by the Critical Appraisal Skills Program (CASP)

No	Assessment Indicators	Publication (Author and Year)				
		Andersen et al. (2014)	**Feyer et al. (2000)**	**Holterman et al. (2013)**	**Vinstrup et al. (2020)**	**Andersen et al. (2019)**
1	Does this research address a clearly focused problem?	2	2	2	2	2
2	Is the group recruited in an acceptable way?	2	2	2	2	2
3	Is exposure accurately measured to minimize bias?	2	2	2	2	2
4	Is the outcome (death status) accurately measured to minimize bias?	2	2	2	2	2
5	Does the author identify all the important confounding factors? Has the author taken into account any confounding factors in the design and/or analysis?	2	2	2	2	2
6	Is the subject follow-up complete enough? Was the follow-up of the subject long enough?	2	2	2	2	2
7	Are the results of this study reported in aOR?	2	2	2	2	2
8	How precise is the result?	2	2	2	2	2
9	Are the results reliable?	2	2	2	2	2
10	Can the results be applied to the local population?	2	2	2	2	2
11	Are the results of this study consistent with other available evidence?	2	2	2	2	2
12	What are the implications of this study for practice?	2	2	2	2	2
	Total	**24**	**24**	**24**	**24**	**24**

Note: 2: Yes; 1: Can't tell; 0: No

Table 2. Quality Assessment of Cross-sectional Study Design Articles

No	Checklist Questions	Publication (Author and Year)				
		Carugno et al. (2012)	Elmannan et al. (2021)	Freimann et al. (2013)	Ghilan et al. (2013)	Ibrahim et al. (2019)
1	Do these objectives clearly address the research focus/problem?	1	1	1	1	1
2	Are cross-sectional study methods suitable for answering research questions?	1	1	1	1	1
3	Is the study subject selection method clearly written?	1	1	1	1	1
4	Is the sampling method free of bias (selection)?	1	0	1	1	1
5	Is the study sample taken representative of the designated population?	1	1	1	1	1
6	Is the sample size based on pre-study considerations?	1	1	1	1	1
7	Is a satisfactory response achieved?	1	1	1	1	1
8	Is the research instrument valid and reliable?	1	1	1	1	1
9	Is statistical significance assessed?	1	1	1	1	1
10	Is a confidence interval given for the main outcome?	1	1	1	1	1
11	Have confounding factors been taken into account?	1	0	0	1	1
12	Do the results can be applied to your study?	1	1	1	1	1
	Total	**12**	**10**	**11**	**12**	**12**

Note: Answer: 1= Yes and 0= No

Table 2. Cont.

No	Checklist Questions	Publication (Author and Year)				
		Jradi et al. (2020)	Rezaee et al. (2014)	Tefera et al. (2021)	Yoshimoto et al. (2019)	Zhang et al. (2019)
1	Do these objectives clearly address the research focus/problem?	1	1	1	1	1
2	Are cross-sectional study methods suitable for answering research questions?	1	1	1	1	1
3	Is the study subject selection method clearly written?	1	1	1	1	1
4	Is the sampling method free of bias (selection)?	1	1	0	1	1
5	Is the study sample taken representative of the designated population?	1	1	1	1	1
6	Is the sample size based on pre-study considerations?	1	1	1	1	1
7	Is a satisfactory response achieved?	1	1	1	1	1
8	Is the research instrument valid and reliable?	1	1	1	1	1
9	Is statistical significance assessed?	1	1	1	1	1
10	Is a confidence interval given for the main outcome?	1	1	1	1	1
11	Have confounding factors been taken into account?	1	1	1	1	0
12	Do the results can be applied to your study?	1	1	1	1	1
	Total	**12**	**12**	**11**	**12**	**11**

Note: Answer: 1= Yes and 0= No

Table 3. Description of the primary studies included in the meta-analysis primary studies

Author (year)	Research location	Study Design	Sample	Exposure	Outcome	aOR (95%)
Andersen et al. (2014)	Denmark, Europe	Cohort	5017 female health workers	Frequency of transfering patients	Back Injury	1.85 (1.15 to 2.97)
Andersen et al. (2019)	Denmark, Europe	Cohort	2080 health workers	Frequency of transfering patients	Back Injury	8.03 (5.26 to 12.27)
Carugno et al. (2012)	Brazil and Italy, Europe	Cross-sectional	751 nurses	Lifting weight	Low back pain	1.15 (0.59 to 2.23)
Elmannan et al. (2021)	Saudi Arabia, Asia	Cross-sectional	323 nurses	Patients require mobilizing Feeling under stress	Low back pain	1.513 (0.52 to 4.39) 1.742 (0.61 to 4.98)
Feyer et al. (2000)	Australia	Cohort	694 nurses	Psychological state	Low back pain	2.68 (1.42 to 5.07)
Freimann et al. (2013)	Estonia, Europe	Cross-sectional	221 female nurses	Emotional exhaustion	Low back pain	2.0 (0.70 to 5.70)
Ghilan et al. (2013)	Yemen, Asia	Cross-sectional	687 female nurses	Stress level at work	Low back pain	2.58 (1.66 to 3.99)
Holterman et al. (2013)	Denmark, Europe	Cohort	1544 health workers	Frequency patient handling activities	Low back pain	1.28 (0.58 to 2.78)
Ibrahim et al. (2019)	Malaysia, Asia	Cross-sectional	1292 nurses	Manual handling Fatigue	Low back pain	1.44 (0.99 to 2.07) 2.63 (1.94 to 3.58)
Jradi et al. (2020)	Saudi Arabia, Asia	Cross-sectional	427 nurses	Work-related stress Frequent lifting objects and patients	Low back pain	4.22 (2.34 to 7.48) 2.04 (1.09 to 3.81)
Rezaee et al. (2014)	Iran, Asia	Cross-sectional	1246 nurses	Frequent carrying	Low back pain	2.513 (1.45 to 4.34)
Tefera et al. (2021)	Ethiopia, Africa	Cross-sectional	412 nurses	Job stress	Low back pain	3.66 (1.95 to 6.49)
Vinstrup et al. (2020)	Denmark, Europe	Cohort	1,944 health workers	Work stress	Low back pain	1.99 (1.49 to 2.66)
Yoshimoto et al. (2019)	Japan, Asia	Cross-sectional	718 nurses	Frequent lifting	Low back pain	0.99 (0.62 to 1.58)
Zhang et al. (2019)	China, Asia	Cross-sectional	1560 ambulance officer	Heavy or awkward lifting Occupational stress	Low back pain	3.72 (1.86 to 7.41) 2.87 (1.30 to 6.30)

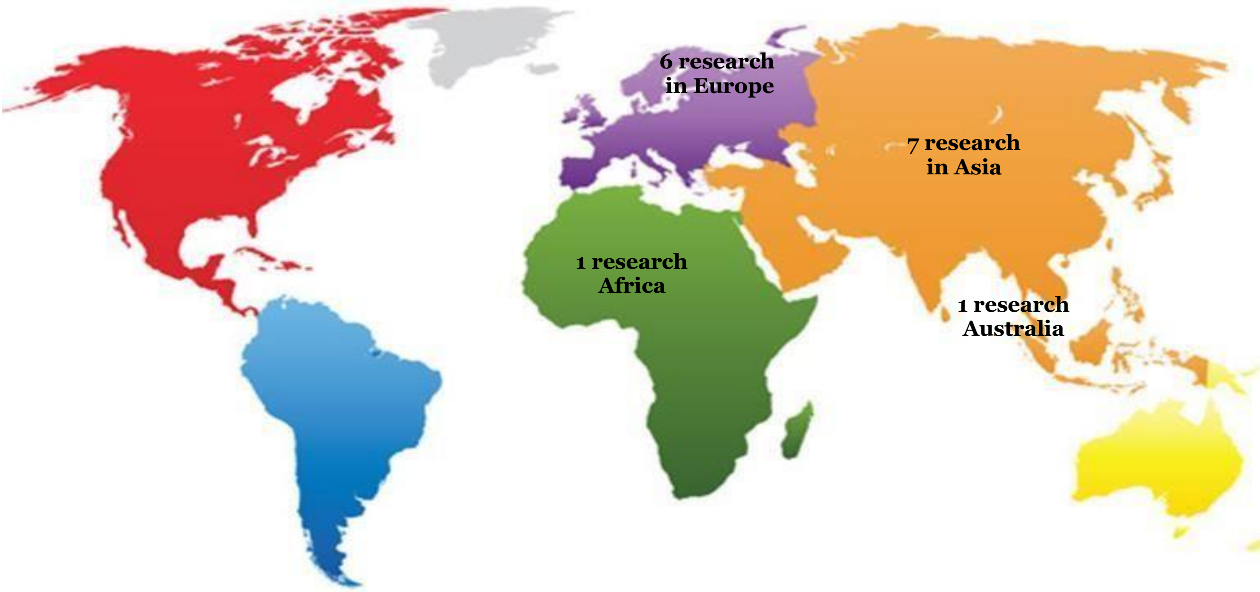

Figure 2. Map of study area

RESULTS

The article search process was carried out through several journal databases including Google Scholar, PubMed, and Science Direct. The review process for related articles can be seen in the PRISMA flow diagram in Figure 1. Work-related/work-related back pain consisted of 15 articles from the initial search process resulting 2,188 articles, after the deletion process of published articles, 1,791 articles were obtained and 201 of them were eligible, then a full text review was conducted. A total of 15 articles that met the quality assessment were included in a quantitative synthesis using meta-analysis.

It can be seen in Figure 2 that the most research site articles were in Denmark with 4 research articles, Saudi Arabia with 2 research articles, and 1 article in China, Japan, Malaysia, Iran, Brazil and Italy, Australia, Yemen, Estonia, and. Table 1 showed that the researchers conducted an assessment of the quality of the study. Table 3 showed 5 articles from a cohort study and 10 articles with a cross-sectional study design as evidence of the association of the influence of work-related back pain.

1. Correlation between occupational stres and low back pain

The results of the Forest plot in Figure 3 showed that there was an effect of job stress on the incidence of back pain. Health workers with high job stress have 2.52 times higher risk for back pain compared to low job stress and the effect was statistically significant (aOR= 2.52; 95% CI= 2.15 to 2.96; p< 0.001).

The results of the funnel plot in Figure 4 showed the distribution of the estimated effects of the various primary studies in this meta-analysis study which was not symmetrical to the right and left of the mean vertical line of the effect estimates. The effect estimates for the primary study were more on the right of the mean vertical line of effect estimates than on the left, indicating publication bias.

2. Correlation between weight lifting heavy load and low back

The results of the Forest plot in Figure 5 showed that there was an effect of the frequency of heavy lifting on the risk of back pain. Health workers with frequent heavy lifting have a risk of experiencing back pain by 2.01 times higher compared to infrequent heavy lifting and this effect and it was Statistically significant (aOR= 2.01; 95% CI= 1.23 to 3.18; p= 0.003).

The results of the Funnel plot in Figure 6 showed an asymmetric distribution of the estimated effect on both sides of the vertical line of the mean effect estimate. The estimated effect was more located on the left of the vertical line than on the right, indicating that there was publication bias. Because the estimated effect was mostly located to the left of the vertical average line of the estimate which was opposite to the location of the diamond shape in the forest plot of Figure 6 which was located on the right line of the vertical line of the zero hypothesis, so publication bias reduced the estimate of the actual effect (under estimate).

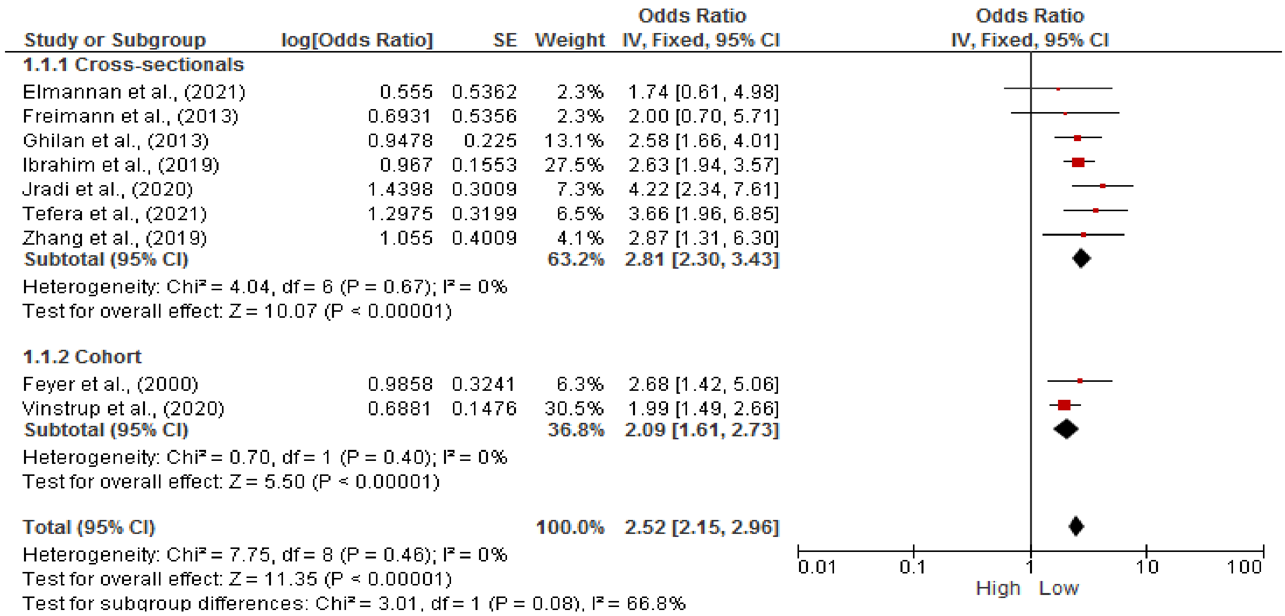

Figure 3. Forest plot of the effect of occupational stress with back pain

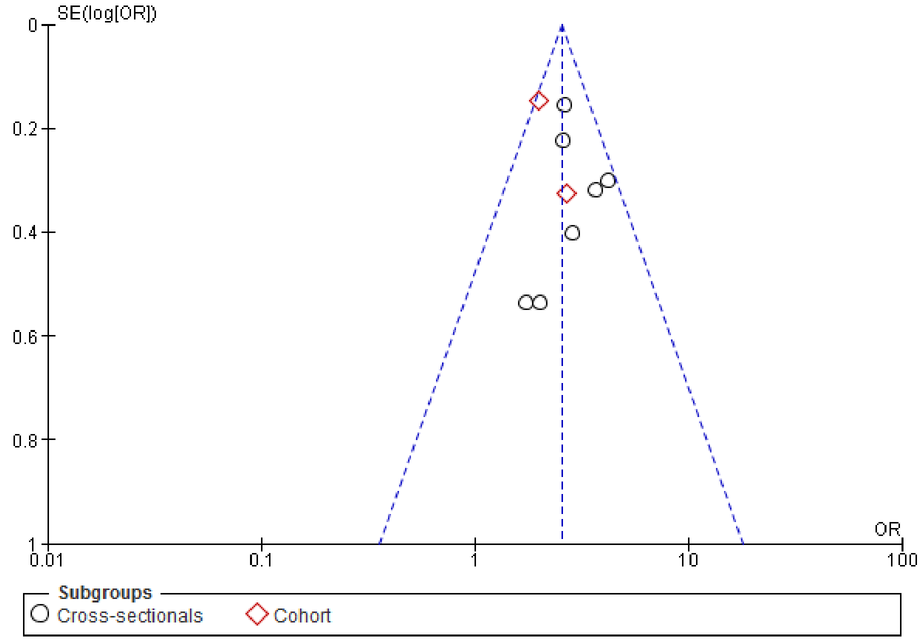

Figure 4. Funnel plot of the effect of occupational stress with back pain

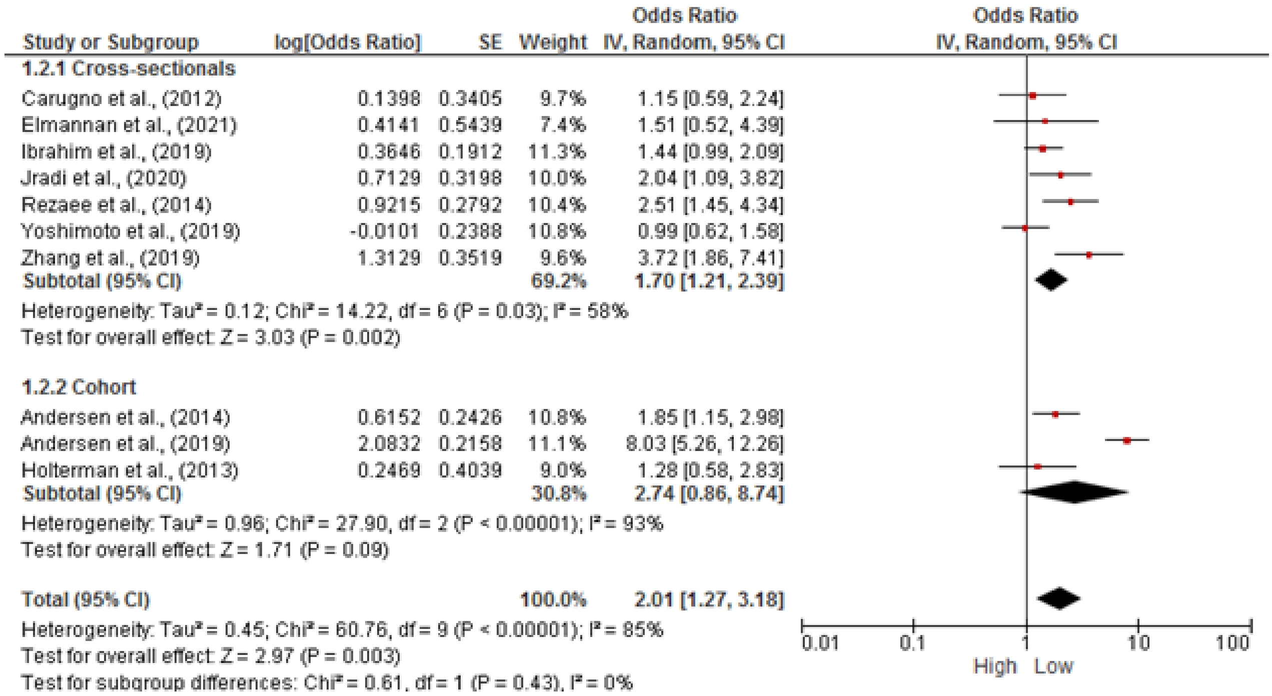

Figure 5. Forest plot of the effect of weight lifting frequency with back pain

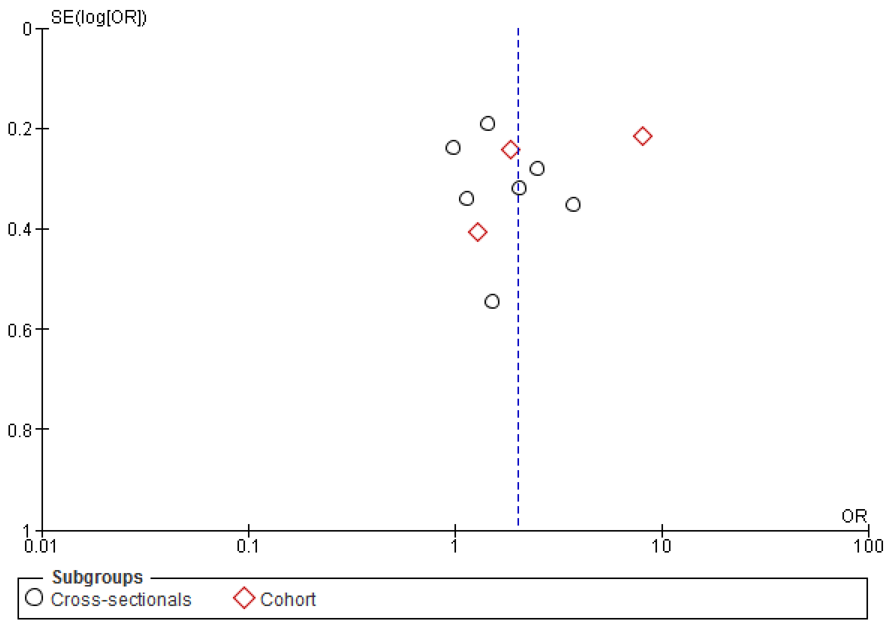

Figure 6. Funnel plot of the effect of weight lifting frequency with back pain

DISCUSSION

This meta-analysis investigated the effect of work stress levels and the frequency of heavy lifting such as patient transfers and lifting or moving patients on the risk of back pain with a sample size of 18,196 medical personnel from 15 primary studies consisting of 5 cohort studies and 10 cross-sectional studies conducted in Asia, Australia, Africa and Europe. The findings of this study explained that the presence of risk factors such as the level of work stress and the frequency of heavy lifting affect the increased risk of back pain among medical workers. The forest plot results revealed that medical workers with high levels of job stress had a higher risk of experiencing back pain compared to medical workers with low levels of work stress (aOR= 2.52; 95% CI= 2.15 to 2.96; p< 0.001). This study also analyzed other risk factors for back pain, namely the frequency of heavy lifting. The results of the forest plot revealed that medical personnel with frequent heavy lifting had a higher risk of experiencing back pain than those with infrequent weight lifting (aOR= 2.01; 95% CI= 1.23 to 3.18; p= 0.003). Consequently, high job stress and frequent heavy lifting may be strong risk factors for the incidence of back pain among medical personnel. The estimated effect estimate was obtained by adjusting the adjusted odds ratio of the study by controlling for confounding factors such as age, gender, race, smoking status, weight, sleep duration, alcohol consumption, education level, household income, occupation, physical activity, and comorbidities.

A study by Sanjoy et al. (2017) conducted on female nurses in Bangladesh explained that the results of multiple logistic regression analysis showed that manual lifting in the work environment had an effect on the incidence of back pain. Nurses who rarely do manual lifting have a 63.5% lower risk of experiencing back pain disorders than nurses who often do manual lifting. This is also supported by the results of research by Alsiddiky et al. (2015) which explained that pulling objects during work was found to be an independent factor associated with back pain which was statistically significant (OR= 3.1; 95% CI= 1.7 to 5.6).

The meta-analysis by Pinheiro et al. (2015) explained that 11 of the 17 research articles in their review reported that depressive symptoms contributed to worse low back pain with an effect size (odds ratio [OR]) ranging from 1.04 to 2.47. Only two studies found no statistically significant association (OR= 1.03; 95% CI= 0.98 to 1.08 and OR= 1.02; 95% CI 0.99 to 1.06). Meta-analysis by Wetler et al., (2014) explained that most studies based on self-reporting results find that people who have a tendency to assume that the worst will happen (catastrophic) affect the severity of back pain that is being suffered. In most studies applying threshold values, patients identified as high catastrophysers experienced worse back pain outcomes than those with low catastrophysers.

Stress is a major factor in modulating the pain system through acute antinociceptive and analgesic mechanisms (Butler, 2009). The stress response is generated through various neurotransmitters (noradrenaline, dopamine, serotonin), peptides (vasopressin), and hormones (cortisol) (McEwen, 1998). The main components are the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system. Hypothalamic triggering by stress results in the secretion of corticotropin-releasing hormone and arginine vasopressin. Adrenocorticotropic hormone is secreted in the posterior pituitary gland and activates noradrenergic neurons in the locus coeruleus/ norepinephrine system in the brain. This has a number of consequences, with the secretion of many different substances, the most important of which is cortisol, which is regulated via a feedback system from the HPA axis. (Guilliams and Edwards, 2010). Chronic stress and chronic repetitive high-intensity stress reactivate this stress response, and repeated cortisol spikes ultimately trigger cortisol dysfunction (Hannibal and Bishop, 2014). Since cortisol is a potent anti-inflammatory agent, this dysfunction leads to dysfunction of the inflammatory response (Tsigos and

Chrousos, 2002; Fries et al., 2005). This can ultimately lead to oxidative and nitrosative stress, free radical damage, cellular injury or aging, and systemic tissue degeneration, which can lead to a variety of symptoms, including chronic pain (Hannibal and Bishop, 2014; Maes et al., 2011; Zunszain et al., 2011). These neuroendocrine mechanisms associated with stress and pain are consistent with the results of this study. The results of the meta-analysis conducted in this study confirmed that higher stress levels were associated with higher OR with chronic back pain, which can be understood based on this mechanism.

AUTHORS CONTRIBUTION

Ahmad Syauqi Mubarok is the main researcher who selected the topic, searched for and collected the data. Argyo Demartoto and Bhisma Murti analyzed the data and reviewed study documents.

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CONFLICT OF INTEREST

There was no conflict of interest.

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