EFFECT OF HEMOGLOBIN LEVELS AND BODY MASS INDEX OF FEMALE WORKERS ON THEIR WORK PRODUCTIVITY: A SYSTEMATIC REVIEW

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ABSTRACT

More young women are working than ever before and they contribute a lot to achieving the company's revenue targets. Work productivity is closely related to the incidence of chronic energy deficiency, obesity, and anemia which are still high in young women in Indonesia. This nutritional problem can be identified by assessing the body mass index (BMI), and hemoglobin levels. How is the effect of BMI and Hb levels related to their work productivity? In this systematic review study, work productivity is described based on the number of work attendance and the number of workers able to accomplish their work. The data were collected from primary research results with the help of PubMed, Science Direct, and Research Gate databases. The keywords used were 'Hemoglobin' or 'BMI' combined with 'Women workers' and 'Productivity'. The data were adjusted to the Selected Reporting Items for Systematic Reviews and the Meta-Analyses chart, and four articles were obtained in which the data were synthesized in a narrative manner. Women workers with obesity were found to be about 20.50%, 2.03% were malnourished and 39.19% were anemic. Productivity and work attendance decreased in those with anemia and low BMI. A person's hemoglobin level and BMI are directly proportional to the productivity level of the women workers.

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INTRODUCTION

Women are the largest portion of the working population in the labor market in Indonesia in the sense that the number of women who are willing to work is a significant contribution to available human resources. Women's participation in various economic activities has increased significantly in all sectors, especially among working young women and in the modern sector[1]. Nutrition for workers has an important role, both for welfare and in the context of increasing discipline and productivity. Lack of nutrition in food consumed by workers will affect the body negatively, such as decreased immunity, lethargy, and decreased body weight, which

in turn results in a lack of enthusiasm and motivation. In such circumstances, the workers can not be expected to achieve optimal work efficiency and productivity[2].

Nutritional status is one of the important factors affecting work productivity. Endurance and the body's ability to do work with adequate productivity will be more owned by individuals with good nutritional status. Nutritional status can be identified through BMI, body fat percentage, and hemoglobin levels[3]. A person's nutritional status can be determined through anthropometric assessment by measuring different dimensions and body composition based on a person's age, gender, and consumption level. BMI was included as an indicator in anthropometric measurements that measured the mass of fat in the body, it has been used in other papers and is an effective indicator used to monitor the nutritional status of adults, especially in regard to body weight[4]. Workers with better nutrition status tend to have better productivity and work capacity. In contrast, workers with poor nutrition status may have poor work quality and accelerated fatigue[5].

Based on the 2018 Basic Health Research in Indonesia, the incidence of Chronic Energy Deficiency (CED) in both non-pregnant and pregnant women was increasing[6]. Likewise, the incidence of anemia increased from 2007 to 2018 at the age of 15-24 years. The incidence of overweight and obesity in adults aged over 18 years was also increasing. The average incidence of obesity in adults was 21.8% and the highest incidence of obesity was 30.2%. CED, overweight, and obesity are nutritional problems that can be identified by assessing nutrition through BMI.

MATERIALS AND METHODS

This systematic review aimed to answer the question of how to describe the productivity of women workers who had adequate nutrition and those who were malnourished. The population sampled were women workers, with interventions in the form of malnourished women workers and the controls were women workers with adequate nutrition, with the outcome of the work productivity. The nutritional status of women workers was illustrated by their hemoglobin (Hb) level and the results of their BMI assessment of whether they are thin, fat, or obese, while the work productivity was defined based on the number of workers attendance and the number of workers able accomplish their work. Then the data were synthesized using meta-synthesis (narrative).

The data were obtained from primary research results and were collected with the help of PubMed, Science Direct, and Research Gate databases. The keywords used were 'Hemoglobin' or 'Body Mass Index' combined with 'Women workers' and 'Productivity'. The data were adjusted to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) charts with a span of the last 10 years from 2012 to 2022.

The data were gathered from journals published both nationally and internationally which cover the relationship between nutritional status in terms of Hb levels and BMI and female labor productivity. The data used were those that met the inclusion criteria, namely research studies that had been published in national and international journals, published within 10 years; the type of the original research articles was observational research. Research studies that can be accessed were

those in full (free full text) using Indonesian and English. Meanwhile, incomplete or multiple data were not used in this study.

Based on predetermined keywords, a total of 4071 journals were generated. There were 3 journals that were eliminated due to duplicates then 4068 journals were screened according to the specified criteria. 3448 journals were eliminated because they did not fall within the specified timeframe of 10 years, and did not use English or Indonesian. 414 journals were excluded because they did not have free full text. Of the 206 remaining journals, we checked again whether they had met what was needed and it turned out that 201 of them were not related to the research topic. After that the remaining 4 journals were included in the systematic review to be extracted and analyzed, from where the conclusions were derived.

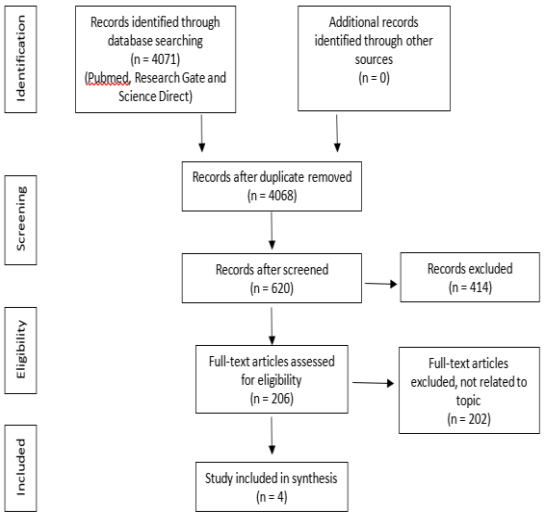

Figure 1. PRISMA Flow chart

RESULTS

Research reviewed by researchers was collected based on the similarity of questions to achieve similar research objectives, which was to find a relationship between hemoglobin and body mass index with work productivity. Due to the limited number of studies, only four were found in this systematic research. The four studies used various research methods, such as A multi-pronged intervention, Cohort Study, and Cross-sectional. The data collection carried out by each researcher involved in this systematic review was classified as primary data. The studies used in this systematic review were carried out between 2013 and 2020. Furthermore, according to the inclusion criteria in this systematic study, the research subjects studied were female and male subjects with an age range of 18 to d 69 years. A total of 4 studies were involved in this poetry service, with a total sample of 63,194 people. The sample size used in each study varied, ranging from 185 respondents to 56,971 respondents, containing two studies on anemia with work productivity and 2 studies on body mass index with work productivity.

Table 1. Selection of research used

No	Title	Research sites	Research time	Research design	Research subject	Inclusion criteria	Exclusion criteria	Independent variables	Dependent variable
1	Weekly dose of iron-folate supplementation with vitamin-C in the workplace can prevent anaemia in women employees	Bangalore City, India	2013 Jan-Mar	A multi-pronged intervention	10,810 worker registered by name and employee number, a random sample of 5% of workers – both male and female – was created, for a total of 515 workers.	Workers based on employee name and number, both male and female.	All who are currently pregnant and those who doubt their gravidity status.	Folate-iron, Vitamin-C	Anemia
2	Occupational differences in BMI, BMI trajectories, and implications for employment status among older U.S. workers	United States (US)	2017 Jan 18	Cohort Study	The respondents are aged 51 to 61. They are working for pay. The unweighted data shows a sample size of 5,523.	Respondents who reported working full or part time, unemployed, or partially retired.	Spouses and spouses who do not meet the age requirements.	BMI	Work productivity
3	Iron status is associated with worker productivity, independent of physical effort in Indian tea estate workers	Darjeeling district in north West Bengal, India	2020 June	Randomized control trial	The Participants were aged 18–55 years with size of 138 experienced tea pickers from Panighatta tea plantation.	Experienced tea pickers from Adivasi or Nepalese ethnicity with age between 18 and 55 years old.	Exceptions for pregnancy, age or severe anemia.	HB	Work productivity
4	Work productivity among adults with varied body mass index: Results from a Canadian population-based survey	Canada	2014 January	Cross sectional	Participants were Canadian Public Health Survey (CCHS) 2009-2010 respondents.	Respondents aged 20-69 who said they had a job before the survey.	The sampling framework excludes individuals living on Indian reserves and Crown.	BMI	Work productivity

In Table 1, the results of the study in Bangalore, India, regarding the relationship between anemia and productivity in poor areas showed that the facilities in the workplace was appropriate to reduce the incidence of anemia while increasing work productivity and efficiency for women workers. The incidence of anemia can be reduced through the administration of folic acid, iron, and vitamin C.

The relationship between BMI and the productivity and work efficiency of women workers was illustrated from the research in the United State, where those with higher job positions are more likely to avoid the incidence of obesity than those in lower positions. This was due to their different lifestyles. The results of the study in Canada indicated that obesity was considered an independent risk factor for decreased work productivity. Obesity was associated with both absenteeism and presenteeism in this study. However, an overweight status was found to be related to work productivity.

Table 2. Overview of the research used

No	Title	Sample size	Research result
1	Weekly dose of iron-folate supplementation with vitamin-C in the workplace can prevent anaemia in women employees	There are 10,810 workers. After registering these workers by name and employee number, a 5% random sample of workers – both male and female – was created, for a total of 515 workers.	The results suggest that in low-resource areas, where the prevalence of anemia is high, the workplace may be considered as an ideal location to deliver doses of folic acid, iron and vitamin-C. Providing folic acid, iron and vitamin C can increase worker efficiency.
2	Occupational differences in BMI, BMI trajectories, and implications for employment status among older U.S. workers	Retirement Attendance (n = 5,937), BMI (n = 5,905), occupation (n = 5,702), retirement date, resulting in a final analysis of 5,523 sample.	The projections indicate that female managers are less likely to be in the ascending obesity trajectory group than female professionals, while female operators, professionals and workers are less likely to be included in the normally stable trajectory class than their colleagues working in manufacturing, agriculture and precision. .
3	Iron status is associated with worker productivity, independent of physical effort in Indian tea estate workers	498 residents were screened and 248 healthy women were eligible for the randomized controlled study.	The results of the intervention providing additional iron can increase worker productivity and work efficiency.
4	Work productivity among adults with varied body mass index: Results from a Canadian population-based survey	The sample consisted of 56,971 respondents between the ages of 20 and 69.	This study found obesity to be an independent risk factor for decreased work productivity. Obesity was associated with both absence and presence. However, the association between obesity and work productivity was weak.

Table 3. Correlation table

No	Title	Independent variables	Dependent variable	Statistical results
1	Weekly dose of iron-folate supplementation with vitamin-C in the workplace can prevent anaemia in women employees	Iron-Folate, Vitamin-C	HB	$\chi 2$ did not show a significant difference in the anemia status of men, a decrease in the number of anemia in women were found to be significant. However, the t test showed that there was a significant change in both groups, both between the matched sample and the unmatched sample ($p < 0.001$).
2	Occupational differences in BMI, BMI trajectories, and implications for employment status among older U.S. workers	BMI	Work productivity	The results shown that women in managerial jobs still have a lower risk of obesity than women in service jobs or those who in professional jobs, even after we assign all women the same values of education, age, race,

				smoking, marital status, assessment of health, and physical activity (P<0.001).
3	Iron status is associated with worker productivity, independent of physical effort in Indian tea estate workers	HB	Work productivity	No significant interaction was found between race and anemia or ID, and only a marginally significant interaction was found between race and IDA (non-IDA Nepali women picked 3.00 kg less tea than non-IDA Adivasi women, p = 0.09; data not shown) in predicting productivity.
4	Work productivity among adults with varied body mass index: Results from a Canadian population-based survey	BMI	Work productivity	The sample consisted of 56,971 respondents between the ages of 20 and 69. Likelihood of absenteeism was higher in obese class III compared with normal BMI (OR = 1.60, 95% CI: 1.39; 1.83). weak presence related to all categories of obesity (OR = 1.49, 95% CI: 1.38; 1.61, for class I obesity). Both absence and presence was associated with slight obesity.

In the research study used to obtain BMI data, the respondents were asked to report their height and weight according to World Health Organization (WHO) BMI classification (kg/m^2): underweight (<18.5), normal (18.5-25), overweight (25–30), obesity class I (30–35), obesity class II (35–40), and obesity class III (over 40). Upon receiving the HB data, blood samples were collected from randomly selected factory workers and analyzed using a computerized non-cyanometo-hemoglobin method. In the other research, the analysis was derived from initial assessments of controlled, randomized, double-blind efficacy trials. The trial conducted was a distribution of double-fortified salt (DFS) with iron and iodine. The participants were selected through blood screenings of adult female plantation residents. Randomized control trials were conducted after excluding pregnancy status, age, or severe anemia (Hgb <80 g/L). There were 63,194 respondents who were involved, and as many as 69 respondents increased their work productivity with indicators of increasing the amount of work and work attendance. There were 35% of the respondents were anemic with Hb levels ranging from 3.0 to 17.8. As much as 1.92% were underweight, 34.52% overweight, and 20.3% obese. The results obtained from the four articles that had been studied showed a relationship between anemia and obesity and the work productivity of women workers.

DISCUSSION

The incidence of anemia in women in poor countries is quite high. The majority of countries on the African continent have an incidence rate of women of reproductive age experiencing anemia above 40%. This is very different when compared to countries in Europe such as the United Kingdom, France, Sweden, and Germany, where the average incidence of anemia in women of reproductive age is only around 15%[7]. In Asia, developing countries such as Pakistan, Myanmar, and India have an incidence rate of anemia that is almost the same as countries in Africa, but in countries such as China, Korea, and Japan, the incidence of anemia in productive age women tends to be the same as in developed countries in Europe. So it can be concluded

that developing countries in various parts of the world have a high prevalence of anemia when compared to developed countries[7].

The condition of anemia causes a decrease in physical ability in terms of work, thereby reducing a person's productivity. In workers who are given iron tablet supplementation along with vitamin C, the incidence of anemia is reduced and it is directly proportional to the increase in their work productivity[8].

Between 1980 and 2013, the global prevalence of overweight and obesity increased by 27.5% in adults and 47.1% in children, with a total of 2.1 billion people considered overweight or obese. The increase in obesity is seen in both developed and developing countries. However, the prevalence of overweight and obesity is found to be higher in developed countries than in developing countries for all age groups. Men were found to be more overweight and obese than women in developed countries. The opposite is instead observed in developing countries[9]. The female population aged 18 years and over with a high BMI tends to be greater in developed countries than in developing countries. In 2016 women in the United States had an average BMI of 28.9, and the country with the highest average BMI was Egypt with almost the same BMI value of 31.4. This is different from developing countries such as India and Vietnam. In India, the average BMI is ranging from 21.9 to 23.8[10].

The BMI has several classifications. The more significant the BMI number, the more the person is obese. This can cause delays in the person's activities because people with excess body weight will require more energy to carry out activities compared to people who have a normal BMI. Being overweight is weakly related to work productivity[11]. Obesity is also closely related to certain environmental factors, genetics, individual behavior, and increased access to health resources, and health care systems[12].

CONCLUSION

There was a relation between the effect of nutritional status in terms of Hb and BMI levels and women's work productivity. The condition of a person's Hb and BMI is directly proportional to the level of productivity of female workers.

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CONFLICT OF INTEREST

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AUTHOR CONTRIBUTION

All authors have contributed separately to all process in this research, which includes preparation, gathering of data and the subsequent analysis, the drafting and approving for the eventual publication of this manuscript.

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