Vol. 9 No. E (2021): E - Public Health

Published: 2021-01-10

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Announcements

Happy New 2023 Year!

January 1, 2023

Dear member,

On behalf of Scientific Foundation SPIROSKI and Open Access Macedonian Journal of Medical Sciences (OAMJMS), we wish you Happy New 2023 Year.

Reduced Publication Fee for Ukraine

April 22, 2022

Open Access Macedonian Journal o Medical Sciences decided to suppo scientific community from Ukraine with reduction of Publication Fee from 400 € (EUR) to 200 € (EUR) till the end of the war.

Scientific Foundation SPIROSKI, Skopje, Republic of Macedonia
Open Access Macedonian Journal of Medical Sciences. 2021 Jul 16; 9(E):552-558.
https://doi.org/10.3889/oamjms.2021.6066
eISSN: 1857-9655
Category: *E - Public Health*
Section: *Public Health Epidemiology*

Food Consumption as a Risk Factor of Anemia among Indonesian Pregnant Women: A Cross-sectional Study among Javanese Ethnic Group

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Edited by: Sasho Stoleski
Citation: Anggraeni MD, Fatoni A, Setiyani R. Food Consumption as a Risk Factor of Anemia among Indonesian Pregnant Women: A Cross-sectional Study among Javanese Ethnic Group. Open Access Maced J Med Sci. 2021 Jul 16; 9(E):552-558. https://doi.org/10.3889/oamjms.2021.6066
Keywords: Anemia; Food consumption; Indonesian; Pregnancy
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Received: 21-Mar-2021
Revised: 23-May-2021
Accepted: 26-Jun-2021

Funding: This research was supported by the Directorate General of Higher Education (DGHE, DIKTI) and Universitas Jenderal Soedirman, through a "Riset Unggulan Perguruan Tinggi" grant No. 068/SP2H/LT/DRPM/IV/2017.
Competing Interests: The authors have declared that no competing interests exist

Abstract

BACKGROUND: Anemia during pregnancy causes several adverse effects. Furthermore, in Indonesia, this leads to restrictions among pregnant women. The information on this situation is still limited, and more research needs to be conducted.

AIM: Therefore, this study aims to investigate the association between food consumption and anemia among pregnant women.

METHODS: This is a cross-sectional descriptive research that involved 424 pregnant women. Furthermore, written informed consent was obtained from respondents before data collection. A self-administered questionnaire was used to assess the food consumption and demographic data. Hemoglobin concentration was further measured using a haemoglobinometer, and data were analyzed using a descriptive statistical Chi-square, and a Multiple Logistic Regression test.

RESULTS: It was found that half of the respondents suffered from anemia (46.5%). Furthermore, the Multiple Logistic Regression test showed that tea, liver, eggs, and iron consumption with values of (odds ratio [OR] = 5.075, $p < 0.001$), (OR = 4.128, $p < 0.001$), (OR = 3.590, $p < 0.01$), and (OR = 3.837, $p < 0.05$), respectively, had significant correlations with anemia among pregnant women.

CONCLUSIONS: Anemia is commonly experienced by Indonesian pregnant women. Therefore, health-care providers should focus on preventing anemia in pregnant women by reducing their tea intake and increasing the consumption of iron-rich foods or supplements.

Introduction

Maternal mortality rate (MMR) is an important indicator when describing a country's social welfare [1]. Furthermore, Indonesia has one of the high MMR among countries in the Asia region [2]. In this country Indonesian Demographic and Health Survey that MMR in the country was 177 per 100,000 live births [3]. According to data from the Ministry of Health, antenatal bleeding was the major cause of maternal mortality in 2019. Furthermore, one-third (30.3%) of Indonesian women die from bleeding during pregnancy processes, childbirth, and postpartum [1].

The risk factors that cause bleeding during childbirth are high maternal age, parity <3, poor birth history, prolonged labor, and anemia [4]. Anemia during pregnancy has a significant relationship with maternal death in low- and middle-income countries [5]. Studies show that there was a significant relationship between anemia during pregnancy and postpartum hemorrhage in Indonesia [6], [7]. In addition, women who experiencing postpartum hemorrhage had a history of suffering from anemia during pregnancy [8].

Anemia during pregnancy is a major health problem. Consequently, data from the Indonesian Basic Health Research showed that the prevalence of anemia among pregnant women in the country increased significantly from 37.1% in 2013 to 48.9% in 2018 [9]. This means that almost half of pregnant women currently suffer from this disease. Therefore, investigating factors that cause anemia in pregnant women is very important.

Anemia during pregnancy is also associated with several factors, such as drinking more than three cups of tea per day before pregnancy, ingestion of clay or dirt during pregnancy, reduced egg intake, consuming less beef [10], meal frequency, dietary diversity, and parity [11]. Tea contains tannin, which is well known as an iron absorption inhibitor, therefore, consuming tea after meals causes a 60% decrease in iron uptake [12]. Furthermore, serum iron and ferritin are significantly

higher in non-tea drinkers compared to tea drinkers [13]. A research showed that the major cause of anemia during pregnancy in Indonesia is iron deficiency [14]. Consequently, humans obtain iron from food because their bodies do not produce it [15]. Studies about the adverse effects of food consumption on pregnancy were mostly conducted in Western [16], [17], [18], [19], [20] and other Asian countries [21], [22]. Therefore, there is few information on the correlation between food consumption and anemia among Javanese pregnant women in Indonesia.

Cultural beliefs during pregnancy contribute to pregnant women's choice of food. This is because, Javanese people have a strong belief that eating foods such as beef, eggs, and fish is a taboo. However, these are foods rich in protein and iron which influence pregnant women's hemoglobin concentration [23]. Another Javanese culture is drinking tea during meals, which causes a decrease in the absorption of non-heme iron, thereby leading to iron deficiency anemia [24], [25]. A randomized control study showed that drinking tea with meals decreases iron absorption. However, taking it after meals reduces the inhibitory effect on iron absorption [26]. Furthermore, components of beverages such as tea, directly affect iron bioavailability and inhibit iron absorption [27]. A recent study showed that the cultural beliefs of Javanese people are changing, particularly among the young generation [28]. Therefore, in order to prevent anemia in pregnant women, it is essential to examine the association between food consumption and this disease.

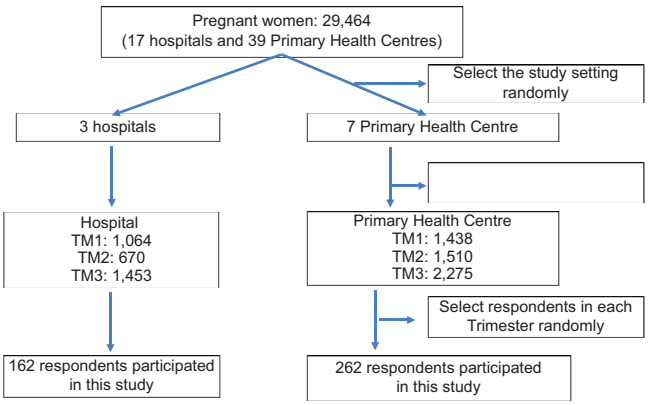
Studies aimed at determining the predictors of anemia during pregnancy have been conducted in Indonesia [14], [29]. However, they only examined the correlation between infectious diseases and the sociodemographic factors of anemia. Studies on anemia in pregnant women need to be updated. According to the Indonesian Ministry of Health's report in 2018, the Central Java Province had a high prevalence of anemia among pregnant women and teenagers. Therefore, this study aimed to determine predictors of anemia among pregnant women in the Central Java Province.

Methods

Research design and participants

This study used a descriptive cross-sectional design, which was conducted in the Central Java Province among Javanese people, the largest ethnic group [30], on the most populous island in Indonesia. The Yamane's formula was used to calculate the subject of research $n = \frac{N}{1 + N(e)^2}$ [31]. The population of pregnant women (n) was 29,464 [32], with a precision of 0.05. Furthermore, the research used 10% of this number as the respondents. Therefore, the required the subjects in this research were 424 respondents.

The research involved 424 respondents which were selected using a random multistage cluster sampling to obtain subjects that represent pregnant women from both rural/urban areas, sub-districts, and health care facilities [33]. These subjects were recruited from 3 antenatal care clinics at the hospital and 7 Primary Health Centres which were selected randomly from 17 hospitals and 39 Primary Health Centres. Furthermore, in each health care facility, pregnant women were categorized into three groups according to their trimester, after which some were randomly selected.



The inclusion criteria of respondents were pregnant women with 4–38 weeks of gestation, routine antenatal care visits, and willingness to participate in this research. Meanwhile, the exclusion criteria included a history of chronic bleeding, thalassemia, malaria, and chronic diseases such as inflammatory bowel movement, autoimmune diseases, cancer, chronic infections and renal failure, solid tumors, and chronic heart failure [34].

Data was collected using a set of questionnaires and a hemoglobinometer. Sociodemographic data were obtained using a self-developed questionnaire based on literature review, and included questions such as maternal and gestational age, parity, education concentration, working status, family income, and abortion history. Data on food consumption were collected using a set of questionnaires and hemoglobin concentrations were measured using a hemoglobinometer.

Data collection

Data were collected from February 2018 to June 2018 by four research assistants with bachelor degrees in Nursing Science. There was a discussion on the purpose, ethics, informed consent, and data collection methods. Data collection only started after receiving the ethical approval and permit from the Indonesian Ministry of Health and Government office

and providing information to respondents related to the research purpose, benefits, procedures, and required time. The respondent was willing to participate in this research signed in a written consent form to show that they understood the research information and had agreed to participate.

Dietary analysis

The variables needed in this research were the frequency of (times/week) red beef, eggs, liver, tea, milk consumption, and the current hemoglobin level. The items such as eggs, beef, liver, and milk were chosen because of their high consumption prevalence among Javanese and their high Fe content. Tea was also chosen because it is a popular beverage and it is usually drinking after meals even though tea inhibits the absorption of Fe in the small intestine. The food consumption frequency questionnaire (FCFQ) and dietary history questionnaire (DHQ) were examined for content validity, language, and cultural suitability by a panel of three experts consisting two faculty members from the Department of Nutrition, Universitas Jenderal Soedirman and a faculty member from Department of Nursing, Universitas Jenderal Soedirman. Then, the reliabilities of instruments were performed with 25 pregnant women. All details of Content Validity Indices (CVI) and reliabilities were explained in each scale.

The back-translation process was performed based on Hilton and Skrutkowski guidelines (2002). The original questionnaires were translated from English into Bahasa Indonesian version. Next, the questionnaires were translated back from Bahasa Indonesian version into the English version. The process was carried out by three bilingual lecturers in Health Sciences with master's degrees from countries where English is the main language. Last, a native English speaker evaluated the original and back-translated questionnaires.

The data on the frequency of beef, liver, and eggs consumptions was collected using a FCFQ developed by Zhao *et al*. (2014). These frequency data were categorized into (1) never or less than once per week, (2) once to 6 times per week, and (3) daily [35]. The categorization is also in accordance with the Indonesian nutrition guidelines [36]. Meanwhile, data was validated with 24-h recall of foods eaten the day before the survey. The CVI of the questionnaire was 0.97 and reliability testing using a Pearson correlation was 1.

Furthermore, data on the frequency of milk and tea consumption was collected using a DHQ created by Okubo *et al*. (1998). The frequency of milk intake was categorized into (1) never or less than a cup per week, (2) once to six cups per week, and (3) daily. Meanwhile, that of tea consumption was categorized into (1) 0–1 cup per day, (2) 2–3 per day, (3) 4–5 daily, and (4) ≥6 cups daily [21]. This categorization is also in accordance with the Indonesian nutrition guidelines [36]. The data was validated with 24-h recall of foods eaten the day before the survey. The CVI of the questionnaire was 0.98 and reliability testing using a Pearson correlation was 0.99.

Blood samples were collected from finger pricks, while hemoglobin concentrations were measured using the EasyTouch®GCHb (Bioptik Technology Inc., Taiwan), with a measuring range of 7–26 g/dL [37]. The respondents were then categorized into anemia (<11 g/dL), and non-anemia (≥11 g/dL) according to their hemoglobin concentrations. Furthermore, pregnant women with anemia were categorized into mild (9–10.9 g/dL), moderate (7–8.9 g/dL), and severe (<7 g/dL) [38].

Data analysis

The data were analyzed using descriptive statistics mean, median, and frequency. The Chi-square test was used to analyze the correlation between beef, liver, eggs, iron tablets, tea, milk consumption, and anemia status. Variables with a p-value of >0.25 were included in a multivariate analysis. Then, Multiple Logistic Regression (with the backward Wald and 95% CI) was used to obtain odds ratios (ORs) and analyze the predictive factors of anemia. Furthermore, the two-tailed p-value of <0.05 was used to indicate the significance. The SAS software version 9.4 (SAS Institute Inc., Cary, NC, USA) was used to perform all the statistical analyses.

Results

Prevalence of anemia

The overall prevalence of anemia was 46.5%, with 86.29% and 13.71% of these anemic respondents having mild and moderate anemia respectively.

Respondents' demographic characteristics

This research involved 424 respondents, each having characteristics described in Table 1. The mean of respondents' age and gestational ages were 27.42 ± SD = 5.9 years and 24.32 ± SD = 10.04 weeks, respectively. Most respondents were in their third trimester (44.3%), multiparous (72.2%), and had graduated from Senior High School (39.6%). They were also housewives (65.6%) with a family income of USD 120 (83.3%). 80.7% had no abortion history and most had a mean hemoglobin concentration of 10.94 ± SD = 1.89 g/dL. Most respondents consumed iron supplementation

Table 1: The research respondents' characteristics (n = 424)

Characteristics	Frequency	Percentage
Age		
<20	32	9.9
20–35	345	79.1
>35	47	11
Parity		
Primipara	118	27.8
Multipara	306	72.2
Pregnancy trimester		
First	126	29.7
Second	110	25.9
Third	188	44.3
Educational level		
Elementary	70	16.5
Junior High School	83	19.6
Senior High School	168	39.6
Diploma	41	9.7
Bachelor	58	13.7
Postgraduate	4	0.9
Working status		
Employee	146	34.4
Housewife	278	65.5
Family income		
<USD 120	71	16.7
≥USD120	353	83.3
Abortion history		
Yes	82	19.3
No	342	80.7
Hb (g/dL)		
<11	197	46.5
≥11	227	53.5
Anemia level		
Mild	27	13.71
Moderate	170	86.29
Iron supplementation		
Yes	332	78.3
No	92	21.7
Liver consumption		
0	258	60.8
1–6	152	39.2
Beef consumption		
0	178	42
1–6	246	58
Eggs consumption		
0	41	9.7
1–6	291	68.6
>7	92	21.7
Tea consumption		
0–1	210	49.5
2–3	108	25.5
4–5	88	20.8
≥6	18	4.2
Milk Consumption		
0	148	34.9
1–6	64	15.1
≥7	212	50

(78.3%) and eggs (68.6%) daily, half drink tea during pregnancy (50.5%). While the others not consume liver (60.8%) as daily intake.

The Chi-square testing results (Table 2) showed that liver, milk, egg, tea, and iron consumption with values of (χ^2 = 4.040, p < 0.001), (χ^2 = 1.255, p < 0.05), (χ^2 = 4.052, p < 0.001), (χ^2 = 7.031, p < 0.001), and (χ^2 = 3.420, p < 0.001) respectively, had significant correlations with anemia risk.

Multiple Logistic Regression and Backward (Wald) testing results (Table 3) revealed that pregnant women with low liver (OR =4.128, p < 0.001), and eggs consumption (OR = 3.590, p < 0.01), iron supplementation (OR = 3.837, p < 0.05) and higher daily tea consumption (OR = 5.075, p < 0.001) were significantly associated with higher anemia risk after analyzing the respondents' characteristics.

Table 2: The correlation of beef consumption, milk consumption, liver consumption, eggs consumption, tea consumption, and iron supplementation with anemia among pregnant women (n = 424)

Variables	χ^2	p
Beef consumption	1.012	0.953
Milk consumption	1.255	0.035
Liver consumption	4.040	<0.001
Eggs consumption	4.052	<0.001
Tea consumption	7.031	0.008
Iron supplementation	3.420	<0.001

Table 3: The logistic regression for predictors of anemia among pregnant women (n = 424)

Variables	B	Wald	OR	95%CI	p
Liver consumption***	1.418	34.175	4.128	2.566-6.640	<0.001
Eggs consumption**	1.278	8.594	3.590	1.527-8.437	0.003
Tea consumption***	1.624	27.831	5.075	2.776-9.279	<0.001
Iron supplementation***	1.345	21.583	3.837	2.176-6.767	<0.001

Values presented as odds ratio (95% of confidence interval), –2 LLχ^2 = 459.72; Hosmer and Lemeshow test (χ^2) = 6.33 (p = 0.50); Cox and Snell R^2 = 0.257, Nagelkerke R^2 = 0.34, *p < 0.05, **p < 0.01, ***p < 0.001.

Discussion

Anemia is a condition where a person's hemoglobin blood concentration is lower normal [39]. This research confirmed that anemia among pregnant women is still high. Furthermore, half of the respondents (46.5%) had this condition, with 86.29% of them having mild anemia, while the remaining (12.69%) had moderate. The result is consistent with data from the Indonesian Basic Health Research [9] which showed that 48.9% of pregnant women aged 25–34 years old were anemic. In this research, pregnant women with low education, multiparous, and low-income families were more likely to become anemic. This is due to lack of anemia prevention knowledge, attitude, and financial problems among families with low education and income.

Intake of iron and protein-rich foods help prevent pregnant women from developing anemia [40]. The result of this study provided consistent data comparing to previous study results on the frequency of iron supplement consumption among pregnant Indonesian women. According to Triharini and Armini (2020), only 52.1% of pregnant women make use of iron tablets [41]. Previous studies showed that at least half of anemia cases during pregnancy are caused by iron deficiency [42], [43]. Therefore, it was concluded that iron supplementation could prevent anemia among Indonesian pregnant women. Mothers' compliance in consuming iron tablets had a significant effect on anemia within pregnant women [44], [45].

The results show that eating liver during pregnancy correlates with lower anemia risk. Most Indonesian people consume chicken liver and cow liver, which contain 9.2–4.8 mg of iron per 75 g (2.5 oz), respectively [46]. Eating liver regularly increases hemoglobin concentration and prevents anemia [47]. The anemic status among Japanese is also significantly correlated with the low intake of animal products containing iron, vitamin B-12, and folate [48].

A research conducted in Pakistan found that consuming eggs has an effect on hemoglobin concentration among pregnant women [10]. Most Indonesian people also eat eggs in their daily meals because they are cheap, easy to find, and prepare. Furthermore, they consume eggs at the rate of 106.418 kg/year [49]. However, the results showed that egg consumption did not prevent anemia among the Indonesian pregnant women, since the egg is considered as a popular food. This is due to the local beliefs among the Javanese which restrict pregnant women from eating foods such as fish and eggs [23].

Those that eat beef as part of their daily diet had higher hemoglobin concentrations when compared to others did not [35]. However, beef consumption did not predict anemia among pregnant women in this research. It was found that only one-third of Indonesian pregnant women eat beef as part of their daily menu [50]. The average beef consumption among Indonesian people is only 0.469 kg/year [49]. This low intake is due to beef's price which is considered expensive. A research conducted in Japan also found that there was no correlation between beef intake and anemia risk among Japanese people [48].

Milk and tea are well-known as an iron absorption inhibitors. The results showed that milk consumption did not have a significant correlation with anemia among pregnant women. This is because Indonesian people believe sweetened cream to be a dairy product when it is not. In fact, sweetened cream lacks proteins present in milk. This observation was recently made by the Indonesian Food and Drug association [51]. Tea consumption correlated with anemia among pregnant women because they drink it during their meals. Indonesia ranked second in tea consumption among countries in the South East area [52]. Almost half of the Indonesian people, including pregnant women drink tea every day as a habit [50], and a part of their culture even though it is not supported with evidence [28].

In this research, the highest prevalence of anemia was found among pregnant women in the third trimester. According to Ward *et al*. (2009), these women have the lowest hemoglobin concentration at 30–34 weeks of pregnancy [53]. The results are consistent with others which found that the third trimester of pregnancy was associated with anemia [54], [55].

The scope of this research covered both rural and urban areas and included local beliefs related to food consumption. Meanwhile, its limitations were respondent's recall bias, research assistants, and hemoglobin measurement method. Consequently, future studies should use better hemoglobin measurement methods, recruit nutritionists as a research assistant, and recruit bigger sample sizes.

Conclusions

This research showed that consumption of iron supplements, iron-rich foods, and tea had significant correlations with anemia among pregnant women. The results suggest that health care providers should consider enhancing the diet of women during pregnancy. This is done by increasing the intake of iron-rich foods and supplements, reducing tea consumption, regular assessment, and intervention at antenatal care. In this cross-sectional study, a relationship was found between risk factors and anemia during pregnancy.

Acknowledgments

The authors are grateful to the participants of the research, and the health providers for generously providing their experience. The authors also thank Nina Setiawati, Waluyo Sejati, Slamet Turah, and Tuti Hartini for their assistance in data collection.

Authors' Contributions

MDA: Project design, manuscript writing, data interpretation, project administration, supervision. AF: Data analysis, manuscript writing, review, and editing. RS: Data collection, writing-review, and editing. All authors have read and approved the final manuscript.

Availability of Data and Materials

The datasets used and/or analysed during this researchare available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

In order to ensure the subjects' human rights, this research obtained an ethical approval from the Institutional Review Board Faculty of Medicine, Universitas Jenderal Soedirman, Indonesia No. 1184/

KEPK/III/2018. The authors also received a permit from the Indonesian Ministry of Health and Government office to conduct this research. They have also provided sufficient information related to the research such as purpose, benefits, procedures, potential risks, required time, anonymity, confidentiality, the subjects' rights to withdraw themselves from this research anytime, and the authors' phone numbers for further questions related to this research if needed. The respondents signed a written consent after stating that they understood the purpose, benefits, potential risks, required time, and procedures were willing to participate. The authors have saved the data using codes, and only them have to access this data.

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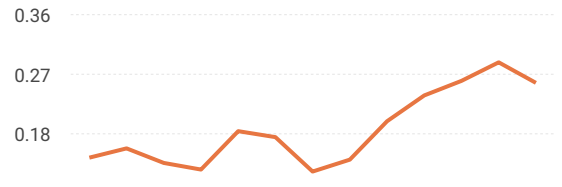

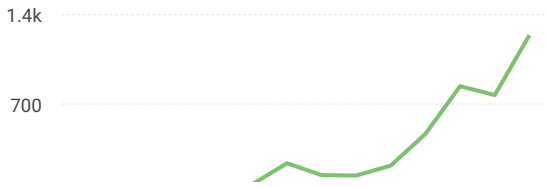

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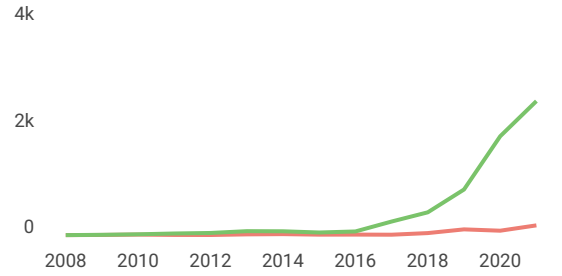

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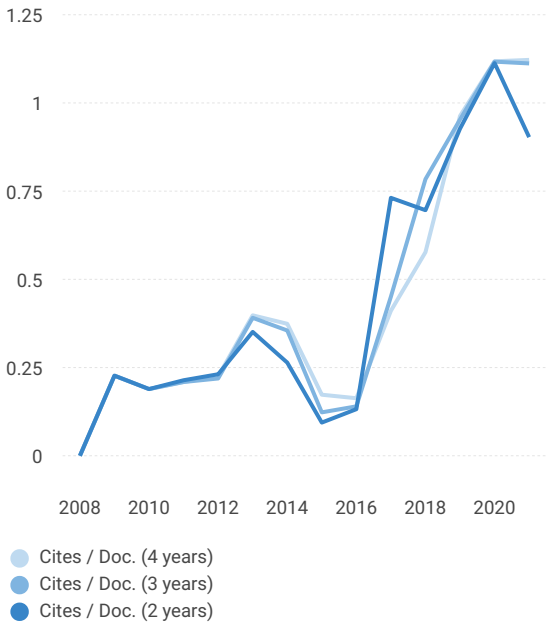

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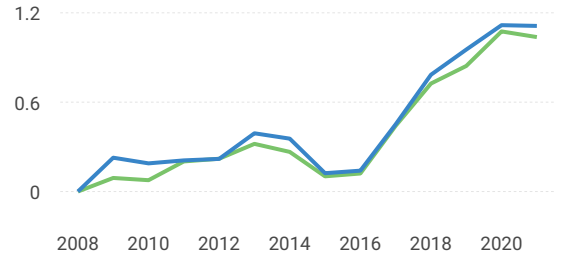

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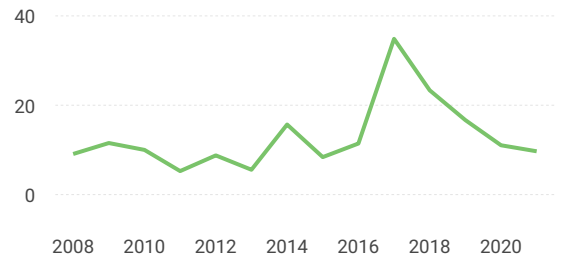

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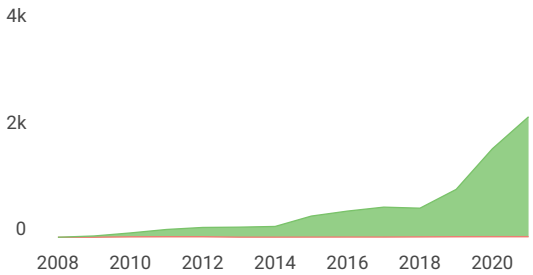

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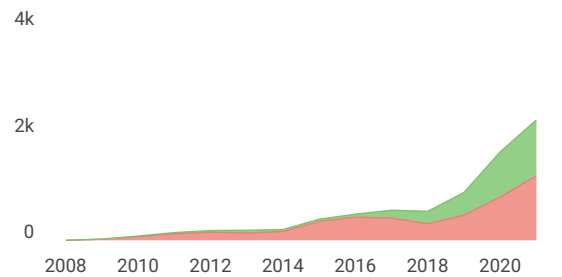

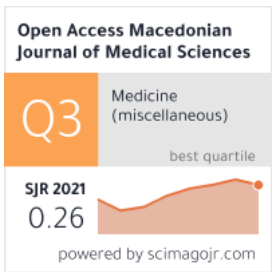

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