

Analysis of donor hemoglobin levels at the blood transfusion service of Dr. Sardjito Hospital, Yogyakarta



Usi Sukorini¹, Galih Retno Martani², Teguh Triyono^{1*}

ABSTRACT

Introduction: Blood service is a health service that utilizes human blood as a basic ingredient for humanitarian and non-commercial purposes. Donors in Indonesia are required to have a minimum Hemoglobin (Hb) level of 12.5 g/dL in accordance with National Regulations. It aims to ensure that the donor can tolerate the loss of blood without the appearance of anemia symptoms. This study aims to analyze the Hb levels of donors at the Blood Transfusion Service of Dr. Sardjito Hospital, Yogyakarta, Indonesia.

Method: This analytic observational study applied a retrospective design. The data of 62,221 donors were taken from the donor database of the Blood Transfusion Service of Dr. Sardjito Hospital. The inclusion criteria were donors aged ≥ 17 years and met other donor selection criteria. Donors with incomplete data were excluded. The chi-Square test was performed using the SPSS version 22. The $p < 0.05$ was considered significant.

Results: The subjects were dominated by male donors, i.e., 48,348 (77.7%), and the most Hb level were 14.1-15.5 g/dL. This range of Hb levels was identified as the highest proportion in all age groups. The Hb levels of 14.1-15.5 g/dL were determined in 5,874 (39.6%) blood group A, 7,332 (39%) blood group B; 1,830 (39.6%) blood group AB and 9,486 (39.5%) blood group O donors.

Conclusions: There was a significant difference in the proportion of donors based on Hb levels, sexes, ABO groups, Rhesus D groups, donation types, and donor statuses ($p < 0.001$).

Keywords: donors, national regulation, hemoglobin levels.

Cite This Article: Sukorini, U., Martani, G.R., Triyono, T. 2023. Analysis of donor hemoglobin levels at the blood transfusion service of Dr. Sardjito Hospital, Yogyakarta. *Bali Medical Journal* 12(2): 2191-2195. DOI: 10.15562/bmj.v12i2.4617

¹Department of Clinical Pathology, Faculty of Medicine, Nursing, and Public Health, Gadjah Mada University/Dr. Sardjito Hospital, Yogyakarta;

²Clinical Pathology Specialist Program, Faculty of Medicine, Nursing, and Public Health, Gadjah Mada University/Dr. Sardjito Hospital, Yogyakarta.

*Corresponding author:

Teguh Triyono;
Department of Clinical Pathology,
Faculty of Medicine, Nursing, and Public
Health, Gadjah Mada University/Dr.
Sardjito Hospital, Yogyakarta;
teguhpk@ugm.ac.id

Received: 2023-05-01

Accepted: 2023-06-22

Published: 2023-07-18

INTRODUCTION

Blood service is a health service that utilizes human blood as a basic ingredient for humanitarian and non-commercial purposes. This health effort to cure diseases and restore health requires the availability of blood or blood components that are sufficient, safe, beneficial, easily accessible, and affordable by the community.¹

Based on the World Health Organization (WHO) guidelines, the target for blood collection should at least constitute 2% of the total population. In the last 10 years, there has been an increase in blood donations in Indonesia, but the demand has not been met. 281 Blood Centers reported that the total whole blood collected in Indonesia in 2016 reached 3,252,077 units. Ninety-two percent of the blood donations were collected from Indonesian Red Cross, and the remaining 8% were collected from the Government/Local Government Blood

Centers.¹

Hemoglobin (Hb) level is an important requirement for donors before donating. It can be measured using several methods based on the availability of blood centers. Point-of-care-testing (POCT) is a fast, valid, simple, widely used hemoglobin screening procedure for donors utilizing capillary blood to obtain healthy and nonanemic donors while maintaining the quality of blood products according to standards.² Donors in Indonesia must have a minimum hemoglobin level of 12.5 g/dL, according to Minister of Health Regulation Number 91 of 2015 on Standards for Blood Transfusion Services.³ Donors in Europe, Singapore, and the United Kingdom must have a pre-donation Hb level of 12.5 g/dL for women and 13.5 g/dL for men, however in the United States, both men and women must have a pre-donation Hb level of 12.5 g/dL. In Australia, donors' pre-donation Hb levels must be 11.5 g/dL

for females and 12.5 g/dL for males, but in New Zealand, donors' pre-donation Hb levels must be 12 g/dL for women and 13 g/dL for men.^{4,5}

The main reason for blood donor deferral is a Hb level of 12.5 g/dL. The Hb test is used to examine the donor's overall health, ensure that the donor can withstand blood unit loss without experiencing anemia symptoms, and ensure that the blood unit's red blood cell concentration fulfills minimal guidelines.^{3,6} It also seeks to ensure that donation does not result in iron insufficiency in people who already have low iron storage. Iron deficiency can impede hematological recovery following whole blood or red blood cell donation.^{4,7}

Every 450-500 mL of blood donated results in a loss of approximately 200-250 mg of iron stores in the body, which is equivalent to a 30% loss of iron stores in men or nearly 80% loss of iron stores in women. Repeated blood donation, short

donation intervals, being female, and having a low iron consumption are all risk factors for iron deficiency in donors.^{8,9} The purpose of this study is to examine the hemoglobin levels of donors at Dr. Sardjito Hospital Yogyakarta's Blood Transfusion Service.

METHODS

A retrospective observational study was used in this investigation. Data were obtained from the donor database of Dr. Sardjito Hospital's Blood Transfusion Service in Yogyakarta, Indonesia. During the year 2017-2019, data on sexes, age groups, ABO blood groups, Rhesus blood groups, hemoglobin levels, donation kinds, and donor statuses were collected. Donors had to be 17 years old and meet other donor selection criteria outlined in Minister of Health Regulation Number 91 of 2015. Donors with incomplete data met the exclusion criteria. SPSS version 22 was used for statistical analysis with the Chi-Square test. If $p < 0.05$, the statistical test is considered significant. The research ethic was issued by the Health Research Ethics Committee of the Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, via an ethical clearance certificate No. KE/FK/1021/EC/2020.

RESULTS

This study enrolled 62,221 subjects consisting of 48,348 (77.7%) male and 13,873 (22.3%) female donors. The median

age of the donors was 29 years, with a range of 17-75 years. The donors were dominated by the 17-30 year age group, i.e., 32,842 (52.8%) donors. Donors with blood group O had the largest number, i.e.,

23,996 (38.6%) donors, followed by those with blood group B 18,781 (30.2%) donors, blood group A 14,826 (23.8%) donors, and blood group AB 4,618 (7.4%) donors. Most of the donors had positive rhesus D

Table 1. Characteristics of the Subjects

Variable	n = 62,221 subjects
Sex	
Male, n (%)	48,348 (77.7%)
Female, n (%)	13,873 (22.3%)
Age (years), median(min-max)	29 (17-75)
17-30 years, n (%)	32,842 (52.8%)
31-40 years, n (%)	13,980 (22.5%)
41-50 years, n (%)	10,326 (16.6%)
51-60 years, n (%)	4,685 (7.5%)
> 65 years, n (%)	388 (0.6%)
Blood group n (%)	
A, n (%)	14,826 (23.8%)
B, n (%)	18,781 (30.2%)
AB, n (%)	4,618 (7.4%)
O, n (%)	23,996 (38.6%)
Rhesus D	
Positive, n (%)	61,937 (99.5%)
Negative, n (%)	284 (0.5%)
Hemoglobin (g/dL)*	14.9 (12.5-17.9)
Donation Type	
Whole blood, n (%)	61,614 (99%)
Plateletpheresis, n (%)	607 (1%)
Donor Status	
Voluntary, n (%)	56,801 (91.3%)
Replacement, n (%)	5,420 (8.7%)

Table 2. The number of donors based on hemoglobin levels and sexes (2017-2019)

Sex	Hemoglobin level (g/dL)						p*
	12.5-14		14.1-15.5		15.6-17.9		
	n	%	n	%	n	%	
Male	7,645	15.8	20,781	43	19,917	41.2	< 0.001
Female	9,594	69.2	3,741	27	536	3.9	

Note: * = analyzed using the Chi-square test

Table 3. The number of donors based on hemoglobin levels and age groups (2017-2019)

Age Group (years)	Hemoglobin level (g/dL)						p*
	12.5-14		14.1-15.5		15.6-17.9		
	n	%	n	%	n	%	
17-30	10,549	32.1	11,826	36	10,465	31.9	< 0.001
31-40	2,954	21.1	5,750	41.1	5,271	37.7	< 0.001
41-50	2,373	23	4,680	45.3	3,273	31.7	< 0.001
> 60	101	26.0	185	47.7	102	26.3	0.436
51-60	1,262	26.9	2,081	44.4	1,342	28.6	

Note: * = analyzed using the Chi-square test

Table 4. The number of donors based on hemoglobin levels and ABO blood groups (2017-2019)

Blood group	Hemoglobin level (g/dL)						p*
	12.5-14		14.1-15.5		15.6-17.9		
	n	%	n	%	n	%	
A	4,258	28.7	5,874	39.6	4,692	31.7	< 0.001
B	5,075	27	7,332	39	6,372	33.9	
AB	1,380	29.9	1,830	39.6	1,408	30.5	
O	6,526	27.2	9,486	39.5	7,981	33.3	

Note: * = analyzed using the Chi-square test

Table 5. The number of donors based on hemoglobin level and Rhesus D blood groups (2017-2019)

Rhesus D	Hemoglobin level (g/dL)						p*
	12.5-14		14.1-15.5		15.6-17.9		
	n	%	n	%	n	%	
Positive	17,205	27.8	24,449	39.5	20,276	32.7	< 0.001
Negative	34	12	73	25.7	177	62.3	

Note: * = analyzed using the Chi-square test

Table 6. The number of donors based on hemoglobin level and donation types (2017-2019)

Donation Type	Hemoglobin level (g/dL)						p*
	12.5-14		14.1-15.5		15.6-17.9		
	n	%	n	%	n	%	
Whole Blood	17,129	27.8	24,200	39.3	20,278	32.9	< 0.001
Plateletpheresis	110	18.1	322	53	175	28.8	

Note: * = analyzed using the Chi-square test

Table 7. The number of donors based on hemoglobin level and donor status (2017-2019)

Donor Status	Hemoglobin level (g/dL)						p*
	12.5-14		14.1-15.5		15.6-17.9		
	n	%	n	%	n	%	
Voluntary	16,246	28.6	22,340	39.3	18,208	32.1	< 0.001
Replacement	993	18.3	2,182	40.3	2,245	41.4	

Note: * = analyzed using the Chi-square test

blood group, i.e., 61,937 (99.5%) donors, and only 284 (0.5%) had negative rhesus D. The median hemoglobin level of the donors was 14.9 g/dL, ranging from 12.5-17.9 g/dL. Whole blood donations reached 61,614 (91.3%) donations, significantly higher than apheresis donations, 607 (1%) donations. The subjects consisted of 56,801 (91.3%) voluntary donors and only 5,420 (8.7%) replacement donors (Table 1).

A significant difference was shown in the proportion of male and female donors based on Hb levels. The most common Hb range level in male donors was 14.1-15.1 g/dL, identified in 20,781 (43%) donors, while that in female donors was 12.5-14 g/dL, identified in 9,594 (69.2%) donors ($p < 0.001$) (Table 2).

The Hb level 14.1-15.5 g/dL was identified in 11,826 (36%) donors aged 17-30 years and 2,081 (44.4%) donors aged 51-60 years. The second most common

range of Hb levels in donors aged 17-30 years was 12.5-14 g/dL, identified in 10,549 (32.1%) donors, while that in donors aged 51-60 years was 15.6-17.9 g/dL, identified in 1,342 (28.6%) donors. There was a significant difference in the proportion of donors in the age group of 17-30 years and 51-60 years based on Hb levels ($p < 0.001$) (Table 3).

Based on blood groups, the most commonly found range of Hb levels was 14.1-15.5 g/dL, identified in 5,874 (39.6%) donors with blood group A; 7,332 (39%) donors with blood group B; 1,830 (39.6%) donors with blood group AB, and 9,486 (39.5%) donors with blood group O. There was a significant difference in the proportion of donors with blood groups A, B, AB, and O based on Hb levels ($p < 0.001$) (Table 4).

The most common range of Hb level in donors with Rhesus D positive was 14.1-

15.5 g/dL, identified in 24,449 (39.5%) donors, while that in donors with Rhesus D negative was higher, i.e., 15.6-17.9 g/dL, identified in 177 (62.3%) donors. There was a significant difference in the proportion of donors with Rhesus D positive and negative based on Hb levels ($p < 0.001$) (Table 5).

The same most common range of Hb level in whole blood and plateletpheresis donations was 14.1-15.5 g/dL, identified in 24,200 (39.3%) and 322 (53%) donors, respectively. There was a significant difference in the proportion of donors in whole blood and plateletpheresis donations based on Hb levels ($p < 0.001$) (Table 6).

The Hb level range of 14.1-15.5 g/dL was identified in 22,340 (39.3%) voluntary donors, while the Hb level range of 15.6-17.9 g/dL was identified in 2,245 (41.4%) replacement donors. There was a

significant difference in the proportion of voluntary donors and replacement donors based on Hb levels ($p < 0.001$) (Table 7).

DISCUSSION

Screening of prospective donors aims to assess the condition of the potential donors for safe donation processes and safely received blood products by recipients. One of the requirements that prospective donors have to meet is having a minimum pre-donation Hb level of 12.5 g/dL as stipulated in the Regulation of the Minister of Health of the Republic of Indonesia Number 91 of 2015.^{3,10}

In this study, the subjects were dominated by male donors, 48,348 (77.7%) donors, while female donors were, 13,873 (22.3%) donors. It is in line with the report of the Ministry of Health of the Republic of Indonesia on blood services in Indonesia in 2016, which stated that 72.5% of blood donations in Indonesia were collected from male donors, and 27.5% were collected from female donors.¹ A previous study conducted by Valerian *et al.* in 2012 in Tanzania stated that 79.1% of blood donations were collected from male donors, and 20.9% were collected from female donors. It results from female donors having low Hb levels, so most of them do not meet the criteria.¹¹ Another study conducted in India also stated that there were more male donors than female donors due to the fact that some women in India suffer from anemia and are underweight, making them unfit to be donors.¹² Fewer women donate their blood regularly than men, one of the reasons being pregnancy and only 42% of women donate their blood again after giving birth.¹³

The most commonly found range of Hb levels in male and female donors were 14.1-15.1 g/dL and 12.5-14 g/dL, respectively. It corresponds to normal Hb levels in adult males ranging from 13.5-18 g/dL and in adult females ranging from 12-15 g/dL.¹⁴ In this study, an Hb level of 14.1-15.5 g/dL was also the most commonly identified in all age groups. Iron deficiency is a frequent complication in the donor population. However, this condition is rarely detected, resulting in a chronic

decrease in Hb and the risk of developing anemia. Restoration of iron stores takes approximately 56 days after donation.¹⁵ A Hb level of < 12.5 g/dL is the main cause of temporary delays in donating blood in various places.¹¹ Donation delays due to low Hb levels occur in approximately 10% of prospective whole blood donors and are generally a consequence of iron deficiency anemia. Women often experience iron deficiency anemia caused by menstruation and pregnancy; thus, they have to delay donating their blood due to low Hb levels.¹⁶ The Hb level of donors will decrease by approximately 0.7-1.5 g/dL after whole blood donation and will last for about 2 weeks. Further hemoglobin recovery begins with reticulocytosis, peaking on day nine, and optimal hemoglobin is obtained approximately 3-4 weeks after donation. Adequate hematopoiesis depends on adequate iron stores.¹⁷

The donors were dominated by those with blood group O, and the least were those with blood group AB. It is in line with the report of the Indonesia Ministry of Health regarding blood services in Indonesia in 2016, stating that donors with blood group AB are the least common, totaling only 8%.¹

The number of plateletpheresis donors was around 1% of total donations. A previous study conducted by Charbonneau *et al.* in 2015 also stated that apheresis donors were fewer than whole blood donors. One of the reasons is that the implementation of apheresis donors is only carried out in several locations far from their homes, and the cost factor is more expensive.¹⁸

A voluntary donor is someone who donates blood, plasma, or other blood components voluntarily and does not accept payment in cash or anything else in lieu of money. A replacement donor is someone who donates blood when needed by members of their family or the community.³ In this study, most of the donors (91.3%) were voluntary donors, with a range of Hb levels of 14.1-15.5 g/dL. Voluntary donors are safer than replacement donors as replacement donors have a higher risk of transmitting infections through the bloodstream than voluntary donors.¹⁹⁻²²

CONCLUSION

There was a significant difference in the proportion of donors based on Hb levels, sexes, ABO groups, Rhesus D groups, donation types, and donor statuses ($p < 0.001$).

ETHICAL CLEARANCE

The research ethic was issued by the Health Research Ethics Committee of the Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, via an ethical clearance certificate No. KE/FK/1021/EC/2020.

CONFLICT OF INTEREST

No author has disclosed any conflicts of interest.

FUNDING

The authors are responsible for the study's funding without the involvement of grants, scholarships, or any other funding resource.

AUTHOR CONTRIBUTION

All authors contributed equally to this study.

REFERENCES

1. Haslinda HI, Maryuningsih YS. Pelayanan Darah di Indonesia. Kemenkes RI. 2018:1-10.
2. Blood Donor Selection: Guidelines on Assessing Donor Suitability for Blood Donation. Geneva: World Health Organization. 2012:1-230. ISBN: 9789241548519.
3. Menteri Kesehatan RI. Peraturan Menteri Kesehatan Republik Indonesia Nomor 91. 2015:1-268.
4. Boulton F. Evidence-based criteria for the care and selection of blood donors, with some comments on the relationship to blood supply, and emphasis on the management of donation-induced iron depletion. *Transfus Med.* 2008;18(1):13-27. doi: [10.1111/j.1365-3148.2007.00818.x](https://doi.org/10.1111/j.1365-3148.2007.00818.x).
5. Zalpuri S, Romeijn B, Allara E, Goldman M, Kamel H, Gorlin J, Vassallo R, Grégoire Y, Goto N, Flanagan P, Speedy J, Buser A, Kutner JM, Magnussen K, Castrén J, Culler L, Sussmann H, Prinsze FJ, Belanger K, Compennolle V, Tiberghien P, Cardenas JM, Gandhi MJ, West KA, Lee CK, James S, Wells D, Sutor LJ, Wendel S, Coleman M, Seltsam A, Roden K, Steele WR, Bohonek M, Alcantara R, Di Angelantonio E, van den Hurk K; BEST Collaborative Study Group. Variations in hemoglobin measurement and eligibility criteria across blood donation

- services are associated with differing low-hemoglobin deferral rates: a BEST Collaborative study. *Transfusion*. 2020;60(3):544-552. doi: [10.1111/trf.15676](https://doi.org/10.1111/trf.15676).
6. Patel AJ, Wesley R, Leitman SF, Bryant BJ. Capillary versus Venous Haemoglobin Determination in the Assessment of Healthy Blood Donors. *Vox Sang*. 2013 May;104(4):317-23. doi: [10.1111/vox.12006](https://doi.org/10.1111/vox.12006).
 7. Eder A, Goldman M, Rossmann S, Waxman D, Bianco C. Selection Criteria to Protect the Blood Donor in North America and Europe: Past (Dogma), Present (Evidence), and Future (Hemovigilance). *Transfus Med Rev*. 2009 Jul;23(3):205-20. doi: [10.1016/j.tmr.2009.03.003](https://doi.org/10.1016/j.tmr.2009.03.003).
 8. Cable RG, Brambilla D, Glynn SA, Kleinman S, Mast AE, Spencer BR, Stone M, Kiss JE; National Heart, Lung, and Blood Institute Recipient Epidemiology and Donor Evaluation Study-III (REDS-III). Effect of Iron Supplementation on Iron Stores and Total Body Iron after Whole Blood Donation. *Transfusion*. 2016;56(8):2005-12. doi: [10.1111/trf.13659](https://doi.org/10.1111/trf.13659).
 9. Kiss JE, Birch RJ, Steele WR, Wright DJ, Cable RG. Quantification of Body Iron and Iron Absorption in the REDS-II Donor Iron Status Evaluation (RISE) Study. *Transfusion*. 2017;57(7):1656-1664. doi: [10.1111/trf.14133](https://doi.org/10.1111/trf.14133).
 10. Astuti Y, Artini D. Comparative Hemoglobin and Hematocrit Before and After Donation To Blood Donate in Unit Transfusion Yogyakarta City. *JRK*. 2019;8(2):40-41. doi:[10.31983/jrk.v8i2.5362](https://doi.org/10.31983/jrk.v8i2.5362).
 11. Valerian DM, Mauka WI, Kajeguka DC, Mgabo M, Juma A, Baliyima L, Sigalla GN. Prevalence and causes of blood donor deferrals among clients presenting for blood donation in northern Tanzania. *PLoS One*. 2018;13(10):e0206487. doi: [10.1371/journal.pone.0206487](https://doi.org/10.1371/journal.pone.0206487).
 12. Koram SK, Sadula M, Veldurthy VS. Distribution of ABO and Rh-blood groups in blood donors at tertiary care centre. *Int J Res Med Sci*. 2014;2(1):326-330. ISSN (o):2321-7251.
 13. Prados Madrona D, Fernández Herrera MD, Prados Jiménez D, Gómez Giraldo S, Robles Campos R. Women as whole blood donors: offers, donations and deferrals in the province of Huelva, south-western Spain. *Blood Transfus*. 2014;1(1):11-20. doi: [10.2450/2012.0117-12](https://doi.org/10.2450/2012.0117-12).
 14. Bain NJ. Rodak's Hematology Clinical Principles and Applications by Keohane EM, Smith LJ, Walenga JM, Elsevier, St Louis. *British Journal of Haematology*. 2016;177(4):662. doi: [10.1111/bjh.14687](https://doi.org/10.1111/bjh.14687).
 15. Schotten N, Pasker-de Jong PC, Moretti D, Zimmermann MB, Geurts-Moespot AJ, Swinkels DW, van Kraaij MG. The donation interval of 56 days requires extension to 180 days for whole blood donors to recover from changes in iron metabolism. *Blood*. 2016;128(17):2185-2188. doi: [10.1182/blood-2016-04-709451](https://doi.org/10.1182/blood-2016-04-709451).
 16. Mast AE. Low Hemoglobin Deferral in Blood Donors. *ransfus Med Rev*. 2014 Jan;28(1):18-22. doi: [10.1016/j.tmr.2013.11.001](https://doi.org/10.1016/j.tmr.2013.11.001).
 17. Cable RG. Hemoglobin determination in blood donors. *Transfus Med Rev*. 1995;9(2):131-44. doi: [10.1016/s0887-7963\(05\)80052-5](https://doi.org/10.1016/s0887-7963(05)80052-5).
 18. Charbonneau J, Cloutier MS, Carrier É. Whole blood and apheresis donors in Quebec, Canada: Demographic differences and motivations to donate. *Transfus Apher Sci*. 2015;53(3):320-8. doi: [10.1016/j.transci.2015.06.001](https://doi.org/10.1016/j.transci.2015.06.001).
 19. Triyono T, Fridawati V, Sukorini U, Mulyono B. Safe Blood and Voluntary Non-Remunerated Blood Donors. *Indo J Clinical Pathol Med Laboratory*. 2014;21(1):20. doi:[10.24293/ijcpml.v21i1.1253](https://doi.org/10.24293/ijcpml.v21i1.1253).
 20. Sharma S, sharma dharmesh chandra, Rai S, Arya A, Jain R, Kaur D, Jain B. Prevalence of ABO, RhD and other clinically significant Blood Group Antigens among blood donors at tertiary care center, Gwalior. *Bali Med J*. [Internet]. 2020 Aug. 1 [cited 2023 Jul. 1];9(2):437-43. Available from: <https://www.balimedicaljournal.org/index.php/bmj/article/view/1779>.
 21. Betti Bettavia Hartama Pardosi, Ni Kadek Mulyantari, Ida Ayu Putri Wirawati, Anak Agung Wiradewi Lestari, Ni Nyoman Mahartini. Overview of transfusion reactions in patients with incompatible crossmatch at Sanglah General Hospital, Denpasar, Bali, Indonesia. *Bali Med J*. [Internet]. 2022 May 31 [cited 2023 Jul. 1];11(2):506-9. Available from: <https://www.balimedicaljournal.org/index.php/bmj/article/view/3605>.
 22. Pradypta PG, Titien I, WM PK. Relationship between the amount of blood transfusion and the amount of iron chelation with blood and salivary ureum levels in children with beta thalassemia major. *Bali Med J*. [Internet]. 2022 Dec. 30 [cited 2023 Jul. 1];11(3):2043-7. Available from: <https://www.balimedicaljournal.org/index.php/bmj/article/view/3488>.



This work is licensed under a Creative Commons Attribution