OPEN ACCESS
Freely Available Online

OpenAccessPub

HEMATOLOGY AND ONCOLOGY RESEARCH
ISSN NO: 2372-6601

Short Communication

DOI : 10.14302/issn.2372-6601.jhor-13-352

Variation In Haemoglobin Reference Ranges And Implications For Use Of Health Service Resource In The Republic Of Ireland And The UK

JM O' Sullivan[1]*, T McNamee[2], JM Harrington[2], IJ Perry[2], MR Cahill[1]

[1]Department of Haematology, Cork University Hospital, Cork, Ireland

[2]Department of Epidemiology & Public Health, University College Cork, Ireland

Abstract

Variation in the lower and upper limits of haemoglobin (Hb) ranges will alter diagnosis and referral rates of anaemia or erythrocytosis. The haemoglobin ranges for adults in Irish laboratories were applied in the context of haemoglobin levels of a representative sample of Irish adults (SLAN). Between 2.8% and 8.5% of men would be diagnosed with anaemia in different laboratories for lower limit between 130-140g/L. For women, diagnosis of anaemia would range from 0.7% to 7.3% for the lower limit between 110-125g/L. Similar reference range variations occur in UK laboratories. A suggested "normal reference range" is extrapolated from the SLAN cohort.

Corresponding author: Jennifer Mary O' Sullivan, Department of Haematology, Cork University Hospital, Wilton Road, Cork, jennifer.m.osullivan@gmail.com

Running title: Variation in haemoglobin reference ranges and implications for use of health service resource in the Republic of Ireland and the UK

Citation: JM O' Sullivan, T McNamee, JM Harrington, IJ Perry, MR Cahill (2014) Variation in Haemoglobin Reference Ranges and Implications for Use of Health Service Resource in the Republic of Ireland and the UK. Journal of Hematology and Oncology Research - 1(1):24-27. https://doi.org/10.14302/issn.2372-6601.jhor-13-352

Key words: Haemoglobin, Anaemia, Referral, Reference range, Health service resources

Received : Nov 24, 2013; **Accepted** : Mar 11, 2014; **Published** ; Mar 31, 2014

Short Communication

A diagnosis of anaemia is considered when the haemoglobin level is below the lower limit of the reference range used by a laboratory and erythrocytosis is diagnosed when the level exceeds the upper limit. Variation in the level of the upper and lower limit will affect diagnosis of these conditions and referral rates. Haemoglobin reference ranges were ascertained for adults in Irish laboratories and in a sample of UK laboratories. The variation in the limits of haemoglobin normal ranges were analysed in the context of findings on haemoglobin concentrations from a large, nationally representative sample of Irish adults.

Haemoglobin reference ranges for adult men and women used in every laboratory in Ireland (n=53) and some in the UK (n=35) were obtained via phone contact, email correspondence or laboratory/hospital websites. Data were also obtained on the type of analyser used in each laboratory and on the source of the reference ranges. Haemoglobin levels were measured in a sample of 1,133 men and women aged ≥45 years, participants in the 2007 Irish National Survey of Lifestyle Attitudes and Nutrition (SLAN 2007)[1].

In Ireland, haemoglobin is tested for both men and women in 53 laboratories and for women alone in 5 laboratories. In adult men, the lower limit varied from 130-140g/L and the upper limit from 167-185g/L. In adult women, the lower limit varied from 110-125g/L and the upper limit from 148-165g/L. At least 14 different analysers were used across the laboratories. Standard haematology textbooks were the confirmed source of reference ranges in at least 6 laboratories. Haemoglobin variation was similar in the sample of UK laboratories; in men, a lower and upper limit varied from 130-135g/L and 166-180g/L respectively and in women, a lower and upper limit varied from 112-120g/L and 145-165g/L, respectively.

Of the representative sample from SLAN 2007, 546 (48.2%) were men and 587 (51.8%) were women. Biomnis laboratory analysed the SLAN data and its reference range was used as the "gold" standard using Sysmex XE 2100 analyser (135-172g/L in adult men, 113-152g/L in adult women). A "true normal" reference range was extrapolated from the SLAN data, excluding those diagnosed as iron deficient (based on a ferritin below the lower limit of normal) and those diagnosed with B12 and folate deficiency. For this range, there was a total 972, of which 437 were male and 535 were female. The range was calculated using the mean (153g/L for men, 140g/dL for women) and standard deviations (11g/L for men, 9g/L for women). The range would be 131-175g/L for men and 122-158g/L for women.

The data demonstrate that there is a wide variation in lower and upper haemoglobin limits in both Ireland and the UK, with an almost 20g/L difference at the upper limit in both genders. A variety of analysers are used in the laboratories and the sources of the reference ranges vary. The use of haematology textbooks in some laboratories in Ireland and the UK as the reference range source is concerning. For haemoglobin, normal values should ideally be derived from a representative sample of healthy persons in whom presence of nutrient deficiency has been excluded[2].

On applying the SLAN data to the variation of haemoglobin reference ranges, there was substantial variation in the proportion of the population that would

Table 1: Shows the variation in proportion of anaemia diagnoses depending on the lower limit of haemoglobin concentration.

Lower Limit Men (g/L)	Anaemia Diagnosis (%)
<130	2.77%
<133	3.75%
<135	4.64%
<136	5.14%
<140	8.53%
Lower Limit Women (g/L)	
<110	0.74%
<113	1.02%
<115	1.21%
<117	1.30%
<118	1.43%
<120	1.94%
<123	5.62%
<125	7.27%

Table 2 Shows the variation in proportion of erythrocytosis diagnoses made.

Upper Limit Men (g/L)	Erythrocytosis Diagnosis (%)
> 167	6.80%
> 170	3.47%
>172	3.02%
>174	1.81%
>175	1.25%
>177	0.45%
>180	0.13%
>185	0.04%
Upper Limit Women (g/L)	
> 148	13.68%
> 150	9.99%
>152	7.59%
>153	5.53%
>157	2.03%
>160	1.82%
>164	1.26%
>165	1.01%

be diagnosed with anaemia or erythrocytosis. Tables 1 and 2 demonstrate the effects of this variation on diagnoses and potential referrals. Given that a diagnosis of anaemia often generates referrals for resource intensive investigations such as endoscopy and GI radiology, over-diagnosis has significant health and resource implications. The Department of Health in the UK previously advised referral for upper and lower endoscopy for men with Hb <110g/L and women with Hb <100g/L[3]. However, British Society of Gastroenterology recommend referral for any level of anaemia (iron-deficient), defining anaemia as "the lower limit of the normal range for the laboratory performing the test" (Grade B evidence)[4]. Likewise, an inappropriately low lower limit or high upper limit could lead to missed/delayed diagnoses of malignancy; those causing anaemia (e.g. GI) or a myeloproliferative neoplasm.

We suggest a normal adult haemoglobin range from the SLAN data which excludes those diagnosed with iron/ B12/folate deficiency. Additionally, given the age of the cohort was ≥45 years, the lower limit of the female range may be higher than would be expected if menstruating females were included. It may be appropriate to consider devising separate normal ranges for premenopausal and postmenopausal women. Haematology laboratory reporting already incorporates multiple age-related normal ranges for neonates and paediatric patients. A further refinement of the normal range for women could easily be incorporated and might result in significant improvement in selection of patients for treatment, investigation and referral.

Our data also suggest it would be advantageous to standardise haemoglobin reference ranges in laboratories throughout the Republic of Ireland and the UK. Such standardisation could lead to appropriate changes in referral patterns for tertiary services and make the evaluation of service use in the future more comparable between regions and countries.

Take Home Messages

- There is a wide variation in lower and upper haemoglobin limits, with an almost 20g/L difference at the upper limit in both genders
- Comparing the ranges to the SLAN data, there was substantial variation in the proportion of this population diagnosed with anaemia or erythrocytosis
- Our data highlights the need to standardise haemoglobin reference ranges in laboratories in the Republic of Ireland and the UK
- We suggest a normal adult reference range based on the SLAN data

Competing Interests

The authors declare that they have no competing interests.

Acknowledgements

We would like to acknowledge the SLAN 2007 Consortium led by Professor Hannah McGee.

References

1. Morgan K McGee H, Watson D et al (2008). SLÁN 2007: Survey of Lifestyle, Attitudes & Nutrition in Ireland. Main Report. Dublin: Department of Health and Children.

2. World Health Organization. Technical Report nr. 503. Nutritional anemias. Geneva:WHO;1972

3. Department of Health. Referral guidelines for suspected cancer. 2000

4. Goddard AF, James MW, McIntyre AS et al. Guidelines for the Management of Iron Deficiency Anaemia *Gut* 2011;60:1309-1316. doi:10.1136/gut.2010.228874