References

Cheah, C.Y., Herbert, K., O'Rourke, K., Kennedy, G., George, A., Fedele, P., Tan, S.Y., Opat, S., Burbury, K., Wolf, M., Januszewicz, E.H., Dickinson, M.J., Westerman, D.A., Prince, H.M., Carney, D.A., Harrison, S.J., Tam, C.S. & Seymour, J.F. (2013) Incorporating high-dose IV methotrexate into initial therapy results in lower rates of central nervous system (CNS) relapse in patients with high-risk diffuse large B-cell lymphoma (DLBCL). *Blood*, **122**, 4353.

McMillan, A., Ardeshna, K., Cwynarski, K., Lyttelton, M., McKay, A. & Montoto, S. (2013) Guideline on the prevention of secondary central nervous system lymphoma: British Committee for Standards in Haematology. *British Journal of Haematology*, **163**, 168–181.

The impact of anaemia on functioning in older people in a rural population in South West Uganda

Information on the impact of anaemia on functioning among older people in Africa is important in terms of identifying targets for intervention and evaluating the impact of treatment programmes for anaemia among the older people. Anaemia has been associated with a number of negative consequences in older people (Guralnik *et al*, 2004; Thein *et al*, 2009). These negative effects can occur because of the adverse effects of anaemia itself or from an underlying disease that caused the anaemia. In Africa, these underlying conditions include human immunodeficiency virus (HIV), malaria and hookworm infection and other prevalent infectious diseases (Balarajan *et al*, 2011).

The limited available data suggest that anaemia is common among older people in Africa (Mugisha *et al*, 2013), and growing numbers of this ageing population will mean that anaemia will become an increasingly important healthcare issue. Data on the association between anaemia and functioning in older people are scarce in Africa. Some authors have even suggested that Blacks may be functionally adapted to low haemoglobin concentrations such that anaemia may not have very serious impact on their functioning (Patel *et al*, 2007).

We conducted an survey about anaemia among 1449 individuals aged ≥50 years (Kowal *et al*, 2000) (response rate 72·3%) in a general population cohort (GPC) (Asiki *et al*, 2013) between January 2012 and January 2013 to study the association between anaemia and functioning. Briefly, the GPC in this population-based cohort study comprises the residents of 25 villages within the Kyamulibwa Sub-county in Kalungu district in rural South-west Uganda. The GPC was established in 1989 by the Medical Research Council/Uganda Virus Research Institute to study the epidemiology of HIV/acquired immunodeficiency syndrome (AIDS) in a general population. Since its inception, annual door-to-door rounds of census and sero-surveys were carried until 2012, when survey methods were changed and participants are now surveyed at central hubs in each of the study villages. The GPC is run from a field station, which has a study clinic and a laboratory where sick survey participants are referred for free treatment. In addition to studying the epidemiology of HIV, the GPC also provides a population for recruitment to other studies, such as this survey about anaemia conducted in the older population. The London School of Hygiene and Tropical Medicine, Uganda Virus Research Institute Science and Uganda National Council for Science and Technology gave ethical approval for the survey. We obtained written/thumb-printed informed consent from all the study participants and all participants requiring medical treatment were referred to the GPC study clinic.

The general methods of the survey within the GPC have been previously described (Mugisha *et al*, 2013) Briefly, the survey was based in the GPC and all older residents (aged 50+ years) of the 25 villages of the GPC were invited to participate. Blood and stool samples were obtained from all the respondents. Haemoglobin was measured using a Coulter AC.T 5 Diff CP analyser (Beckman Coulter Inc., Miami, FL, USA) and stool samples were examined using appropriate methods for hookworm infection. HIV data was extracted from the existing GPC databases. Data on sociodemographic factors and comorbidities were collected using a questionnaire. Functioning was measured subjectively using the World Health Organization (WHO) Disability Assessment Schedule 2.0 (WHODAS 2.0) questionnaire (Üstün & Chatterji, 2010); fatigue and self-rated health and were objectively assessed using grip strength and walking speed. Data were analysed using STATA version 11 (Stata Corporation, College Station, TX, USA). Detailed study methods and results are given in the on-line supporting information.

The majority of respondents (58%) were women. The haemoglobin (Hb) values ranged from 44–204 g/l [standard deviation (SD) 1·6] In total, 294 (20·3%) of the study participants had WHO-defined anaemia: Hb thresholds <130 g/l for men and <120 g/l for women (WHO, 1968). Only a few study participants (0·5% men and 0·7% women) had severe anaemia (Hb <80 g/l). Among men, those with anaemia had

Table I. Descriptive statistics for measures of functioning by sex and anaemia.

	Males		Females	
	No anaemia (n = 459) Median (IQR)	Anaemia (n = 146) Median (IQR)	No Anaemia (n = 696) Median (IQR)	Anaemia (n = 148) Median (IQR)
WHODAS domains				
Understanding/communicating	0 (0–0)	0 (0–10)	0 (0–5)	0 (0–10)
Getting around	0 (0–12·5)	6·3 (0–37·5)	12·5 (0–37·5)	18·8 (0–43·7)
Self-care	0 (0–0)	0 (0–10)	0 (0–0)	0 (0–0)
Getting along with others	0 (0–8·3)	0 (0–16·7)	4·2 (0–16·7)	8·3 (0–16·7)
Life activities (household)	0 (0–10·0)	0 (0–40·0)	0 (0–40·0)	0 (0–50·0)
Participation in society	0 (0–0)	0 (0–33·3)	0 (0–25·0)	0 (0–31·2)
WHODAS summary score[1]	1·1 (0–8·7)	3·3 (0–21·7)	6·5 (2·2–20·7)	6·5 (2·2–24·5)
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Grip strength (kg)	29·1 (7·0)	24·4 (9·7)	19·3 (5·3)	18·7 (5·2)
Normal walk time (seconds)	5·26 (1·77)	6·43 (3·69)	6·50 (2·93)	6·65 (2·80)
Rapid walk time (seconds)	2·94 (1·05)	3·84 (3·41)	3·82 (1·95)	3·78 (1·50)
	n (col %)	n (col %)	n (col %)	n (col %)
Fatigue in past 7 d				
No	211 (46)	50 (34)	245 (35)	49 (33)
Yes	188 (41)	75 (51)	372 (53)	80 (54)
Don't know	60 (13)	21 (14)	79 (11)	19 (13)
Self-rated health				
Very good	77 (17)	14 (10)	67 (10)	11 (7)
Good	161 (35)	46 (32)	202 (29)	41 (28)
Moderate	99 (22)	37 (25)	198 (28)	33 (22)
Poor	58 (13)	27 (18)	146 (21)	44 (30)
Very poor	3 (0·7)	1 (0·7)	3 (0·4)	0 (–)
Don't know	61 (13)	21 (14)	80 (11)	19 (13)

SD, standard deviation; IQR, interquartile range; 95% CI, 95% confidence interval; col %, column percentages of those with or without fatigue and self-rated health in males and females with and without anaemia.

Females have significantly higher domain-specific and overall World Health Organization Disability Assessment Schedule (WHODAS) scores than males (Mann–Whitney U-test), and a lower proportion of 0 scores (Chi-squared test). Among males, those with anaemia have significantly higher domain-specific and overall WHODAS scores than those without anaemia, and a significantly lower proportion of 0 scores. Among females, there is no evidence of a significant difference in WHODAS scores between those with anaemia and those without anaemia, or in the proportion with 0 scores.

[1]Calculated from 32 items in six domains (four items excluded from the analysis).

significantly higher domain-specific and overall WHODAS 2.0 scores compared to those without anaemia, indicating poorer functioning (Table I). The mean hand grip strength in men with anaemia was significantly lower than in men without anaemia (24·4 kg vs. 29·1 kg, $P < 0·001$). There was no significant relationship between anaemia and normal or rapid walk for either men or women. There was also no association between anaemia and fatigue or self-rated health.

Multivariate analyses showed that anaemia was associated with increased odds of having lower hand grip strength in men but not in women [Odds ratio (OR) 4·73, 95% confidence interval (CI) 6·17–3·28] (Table II). After adjusting for sociodemographic and clinical factors, men with anaemia had a 10% longer walk time (geometric mean ratio 1·10, 95% CI 1·02–1·18) compared to those without anaemia. For both men and women, there was no association between anaemia and WHODAS score, fatigue or self-rated health. Adjustment for comorbidities did not alter these results.

Contrary to studies undertaken in high income countries (Penninx *et al*, 2004), we found an association between anaemia and grip strength only in men. In addition, we did not find an association between anaemia and functional limitations, unlike a recent study in South America (Bryce *et al*, 2013). We have no clear explanation for the differences in the association between anaemia and handgrip strength in men and women in our population.

To the best of our knowledge, this is the first study in Africa to investigate the effect of WHO-defined anaemia on functioning in older people. This study used both objective and subjective measures of functioning. We also measured known comorbidities in older people with anaemia, although many of these older people with anaemia may have had subclinical disease and other comorbidities that we were unable to measure.

It is possible that we did not find a strong association between WHO-defined anaemia and functioning in older people because the haemoglobin cut-off levels for anaemia we used are inappropriate for this group in our setting.

Table II. Association of anaemia with functioning as assessed by objective and subjective measures, unadjusted and adjusted for potential confounder.

Objective measures	Males	Females
Grip strength (kg)	Regression coefficient (95% CI)	Regression coefficient (95% CI)
Model 1	$P < 0{\cdot}001$	$P = 0{\cdot}25$
Any anaemia (unadjusted)	−4·73 (−6·17, −3·28)	−0·56 (−1·51, 0·39)
Model 2	$P < 0{\cdot}001$	$P = 0{\cdot}12$
Any anaemia, adjusted for sociodemographic factors‡	−2·45 (−3·76, −1·14)	−0·68 (−1·55, 0·19)
Model 3	$P = 0{\cdot}002$	$P = 0{\cdot}09$
Any anaemia, adjusted for sociodemographic and clinical factors§	−2·07 (−3·37, −0·77)	−0·79 (−1·70, 0·12)
Normal walk time (S)	Geometric mean ratio (95% CI)	Geometric mean ratio (95% CI)
Model 1	$P < 0{\cdot}001$	$P = 0{\cdot}35$
Any anaemia (unadjusted)	1·17 (1·09, 1·25)	1·03 (0·97, 1·09)
Model 2	$P = 0{\cdot}004$	$P = 0{\cdot}37$
Any anaemia, adjusted for sociodemographic factors‡	1·10 (1·03, 1·18)	1·03 (0·97, 1·09)
Model 3	$P = 0{\cdot}005$	$P = 0{\cdot}17$
Any anaemia, adjusted for sociodemographic and clinical factors§	1·10 (1·03, 1·17)	1·04 (0·98, 1·11)
Rapid walk time (s)	Geometric mean ratio (95% CI)	Geometric mean ratio (95% CI)
Model 1	$P < 0{\cdot}001$	$P = 0{\cdot}55$
Any anaemia (unadjusted)	1·19 (1·09, 1·29)	1·02 (0·96, 1·08)
Model 2	$P = 0{\cdot}02$	$P = 0{\cdot}48$
Any anaemia, adjusted for sociodemographic factors‡	1·10 (1·02, 1·20)	1·02 (0·96, 1·08)
Model 3	$P = 0{\cdot}02$	$P = 0{\cdot}27$
Any anaemia, adjusted for sociodemographic and clinical factors§	1·10 (1·02, 1·18)	1·03 (0·98, 1·09)

Subjective measures	Males	Females
Self rated health¶,*	Odds ratio†† (95% CI)	Odds ratio†† (95% CI)
Model 1	$P = 0{\cdot}02$	$P = 0{\cdot}11$
Any anaemia (unadjusted)	1·61 (1·15, 2·39)	1·33 (0·93, 1·91)
Model 2	$P = 0{\cdot}97$	$P = 0{\cdot}04$
Any anaemia, adjusted for sociodemographic factors‡‡	0·99 (0·65, 1·51)	1·45 (1·01, 2·09)
Model 3	$P = 0{\cdot}75$	$P = 0{\cdot}06$
Any anaemia, adjusted for sociodemographic and clinical factors§§	0·89 (0·42, 1·88)	1·91 (0·98, 3·71)
Fatigue**	Odds ratio (95% CI)	Odds ratio (95% CI)
Model 1	$P = 0{\cdot}01$	$P = 0{\cdot}72$
Any anaemia (unadjusted)	1·68 (1·12, 2·53)	1·08 (0·73, 1·59)
Model 2	$P = 0{\cdot}23$	$P = 0{\cdot}55$
Any anaemia, adjusted for sociodemographic factors‡‡	1·32 (0·84, 2·05)	1·13 (0·76, 1·69)
Model 3	$P = 0{\cdot}26$	$P = 0{\cdot}13$
Any anaemia, adjusted for sociodemographic and clinical factors§§	1·59 (0·71, 3·58)	1·75 (0·84, 3·63)
WHODAS score¶	Odds ratio†† (95% CI)	Odds ratio†† (95% CI)
Model 1	$P < 0{\cdot}001$	$P = 0{\cdot}36$
Any anaemia (unadjusted)	1·92 (1·37, 2·70)	1·16 (0·84, 1·60)
Model 2	$P = 0{\cdot}25$	$P = 0{\cdot}15$
Any anaemia, adjusted for sociodemographic factors‡‡	1·24 (0·86, 1·77)	1·27 (0·91, 1·78)
Model 3	$P = 0{\cdot}89$	$P = 0{\cdot}11$
Any anaemia, adjusted for sociodemographic and clinical factors§§	0·96 (0·49, 1·87)	1·62 (0·90, 2·91)

WHODAS, World Health Organization Disability Assessment Schedule; 95% CI, 95% confidence interval.

Objective measures: *Calculated from 32 items in six domains. ‡Adjusted for age, marital status and education. §Adjusted for age, marital status, education, BMI, HIV serostatus, hypertension, number of self-reported conditions, malaria infection, and intensity of hookworm infection. ††Proportional odds ratio from ordinal logistic regression.

Subjective measures: ¶Participant's self-rated health as good, moderate or bad. **Exclude 'don't know'. ††Proportional odds ratio from ordinal logistic regression. ‡‡Adjusted for age, marital status and education. §§Adjusted for age, marital status, education, BMI, HIV serostatus, hypertension, number of self-reported conditions, malaria infection, and intensity of hookworm infection.

Therefore, there is a need for more studies using longitudinal data to study the impacts of anaemia on functioning and mortality in older people in Africa and this will help settle the issue of whether the WHO definition of anaemia is suitable for the older members of our study population in East Africa.

Acknowledgements

We would like thank Mbabazi Pelegrino, C D Mweruka and Vicky Nakibirango for participating in data collection. The funding support of the Medical Research Council/Uganda Virus Research Institute is gratefully acknowledged.

Author contributions

Conceived and designed the study: JOM KB JS HK. Acquisition of data: JOM JS. Managed and analysed the data: KB JM. Interpreted data: JOM KB JS HK. Drafted the article or revised it critically for important intellectual content: JOM KB JS HK. Approved the version of the article: JOM KB JS HK.

Conflict of interest

None.

Joseph O. Mugisha[1,2]
Kathy Baisely[2]
Janet Seeley[1,2]
Hannah Kuper[2]
[1]*MRC/UVRI Uganda Research Unit on AIDS, Entebbe, Uganda, and*
[2]*London School of Hygiene and Tropical Medicine, London, UK*
E-mail: joseph.mugishaokello@lshtm.ac.uk

Keywords: anaemia, functioning, older people, Uganda

First published online 28 July 2014
doi: 10.1111/bjh.13018

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Data S1. Study methods.

References

Asiki, G., Murphy, G., Nakiyingi-Miiro, J., Seeley, J., Nsubuga, R.N., Karabarinde, A., Waswa, L., Biraro, S., Kasamba, I. & Pomilla, C. (2013) The general population cohort in rural south-western Uganda: a platform for communicable and non-communicable disease studies. *International Journal of Epidemiology*, **42**, 129–141.

Balarajan, Y., Ramakrishnan, U., Ozaltin, E., Shankar, A.H. & Subramanian, S.V. (2011) Anaemia in low-income and middle-income countries. *Lancet*, **378**, 2123–2135.

Bryce, R.M., Salas, A., Acosta, D., Jimenez-Velazquez, I.Z., Llibre-Rodriguez, J.J., Sosa, A.L., Teruel, B.M., Valhuerdi, A., Ferri, C.P., McKeigue, P. & Prince, M.J. (2013) The prevalence, correlates and impact of anaemia among older people in Cuba, Dominican Republic, Mexico, Puerto Rico and Venezuela. *British Journal of Haematology*, **160**, 387–398.

Guralnik, J.M., Eisenstaedt, R.S., Ferrucci, L., Klein, H.G. & Woodman, R.C. (2004) Prevalence of anemia in persons 65 years and older in the United States: evidence for a high rate of unexplained anemia. *Blood*, **104**, 2263–2268.

Kowal, P.R., Wolfson, L.J. & Dowd, J.E. (2000) Creating a minimum data set on ageing in sub-Saharan Africa. *Southern African Journal of Gerontology*, **9**, 18–23.

Mugisha, J.O., Baisley, K., Asiki, G., Seeley, J. & Kuper, H. (2013) Prevalence, types, risk factors and clinical correlates of anaemia in older people in a rural Ugandan population. *PLoS ONE*, **8**, e78394.

Patel, K., Harris, T., Faulhaber, M., Angleman, S., Connelly, S., Bauer, D., Kuller, L., Newman, A. & Guralnik, J. (2007) Racial variation in the relationship of anemia with mortality and mobility disability among older adults. *Blood*, **109**, 4663.

Penninx, B.W.J.H., Pahor, M., Cesari, M., Corsi, A.M., Woodman, R.C., Bandinelli, S., Guralnik, J.M. & Ferrucci, L. (2004) Anemia is associated with disability and decreased physical performance and muscle strength in the elderly. *Journal of the American Geriatrics Society*, **52**, 719–724.

Thein, M., Ershler, W.B., Artz, A.S., Tecson, J., Robinson, B.E., Rothstein, G., Liede, A., Gylys-Colwell, I., Lu, Z.J. & Robbins, S. (2009) Diminished quality of life and physical function in community-dwelling elderly with anemia. *Medicine*, **88**, 107.

Üstün, B. & Chatterji, S. (2010) World Health Organization Disability Assessment Schedule II (WHO DAS II): development, psychometric testing and applications. *Bulletin of the World Health Organization*.

WHO (1968) Nutritional Anaemias. Report of WHO Scientific Group. World Health Organisation, Geneva.