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Short Communication

Prevalence of vitamin D insufficiency and risk factors for type 2 diabetes and cardiovascular disease among African migrant and refugee adults in Melbourne

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Migration to industrialised countries poses a “double whammy” for type 2 diabetes among sub-Saharan African migrant and refugee adults. This population group has been found to be at an increased risk of obesity and type 2 diabetes, which may be further aggravated by inadequate vitamin D status. Thus, this study aimed to describe the demographics of vitamin D insufficiency, obesity, and risk factors for type 2 diabetes among sub-Saharan African migrants and refugees aged 20 years or older living in Melbourne, Australia (n=49). Data were obtained by a questionnaire, medical assessment, and fasting blood samples. The mean serum 25-hydroxyvitamin D level was 27.3 nmol/L (95% CI: 22.2, 32.4 nmol/L); with 25-hydroxyvitamin D levels <50 nmol/L occurring in 88% of participants. Participants displayed a cluster of risk factors for type 2 diabetes and cardiovascular disease: 62% were overweight or obese, 47% had insulin resistance (HOMA-IR ≥ 2), 25% had low density lipoprotein cholesterol levels ≥ 3.5 mmol/L, 24.5% had high density lipoprotein cholesterol levels ≤ 1.03 mmol/L, 34.6% had borderline or high levels of total cholesterol (≥ 5.2 mmol/L), 18.2% had borderline or high levels of triglyceride (≥ 1.7 mmol/L), and 16% had hypertension (systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg). These findings suggest that sub-Saharan African migrants and refugees may be at risk of type 2 diabetes and atherosclerosis-related diseases such as ischemic heart disease, stroke, and peripheral vascular disease. Well-designed vitamin D interventions that incorporate lifestyle changes are urgently needed in this sub-population.

Key Words: vitamin D insufficiency, fasting plasma glucose, African migrants and refugees, insulin resistance, obesity

INTRODUCTION

The number of Sub-Saharan African (SSA) migrants and refugees relocating to high income countries such as Australia, Western Europe, Canada, and the United States of America has been increasing over the last two decades.¹⁻⁵ Upon arrival in their host countries, SSA migrants and refugees have been found to be at increased risk of obesity and type 2 diabetes (T2D).⁶⁻¹⁰ This increased risk of obesity and T2D rises further with longer length of resettlement, peaking within 5-10 years after migration. Obesity is known to be a major risk factor for T2D, both total-body and central abdominal obesity are strongly related to insulin resistance, a precursor of T2D.^{11,12} However, for SSA migrants and refugees the risk of T2D could be further aggravated by vitamin D insufficiency (VDI).¹³ Australian and overseas studies have found that SSA migrants are at increased of VDI following migration to industrialised countries.¹⁴⁻¹⁷ These studies have found that VDI is associated with Muslim religion, younger age, female gender, longer length of stay in the

host country, covering clothing, decreased daylight exposure, and testing vitamin D levels during winter or spring. Available evidence suggest that VDI is a risk factor for the metabolic syndrome, which is characterised by a clustering of hyperglycaemia, abdominal obesity, dyslipidaemia, and hypertension.¹⁸ It has been noted that 25-

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Manuscript received 26 November 2010. Initial review completed 31 January 2011. Revision accepted 1 March 2011. hydroxyvitamin D (25-OHD) is negatively correlated with fasting plasma glucose, fasting insulin, and insulin resistance.^{13,19}

These findings indicate that VDI is a risk factor for the metabolic syndrome and suggest that understanding the role of VDI in the cardiovascular health burden should be a priority to assess whether lower levels of serum 25-OHD among SSA migrants and refugees predisposes them to the metabolic syndrome. However, before such a study takes place, an inventory of the components of the metabolic syndrome among this sub-population must first be established. Therefore, the purpose of this study was to describe the demographics of VDI, obesity, and risks of T2D, among SSA migrants and refugees in the western metropolitan region of Melbourne, Australia.

MATERIALS AND METHODS

Participants and recruitment

Study participants were newly arrived SAA migrants and refugees, aged ≥ 20 years, who had not taken any vitamin D supplements in the two years prior to the study. The study targeted local government areas in the western metropolitan region of Melbourne (Wyndham, Maribyrnong, Moonee Valley, and Brimbank), where the number African migrants and refugees is estimated to be about 21,720 people.¹ Participants were recruited by collaborating with the staff of three community and health centres who helped to promote the study, and the study was advertised via 60 posters that were displayed in the centres and at the Footscray market. In addition, 220 leaflets in Arabic were distributed through community centres, refugee health programs, African community workers, women's groups, the African Review Panel (ARP), and general medical practices. The project was publicised in the Star News Group, complemented by a SBS radio announcement in Arabic. All promotion of the study instructed interested participants to contact members of the research team (a contact number was provided). Fifty five participants responded to our call for participation and received further information about the project through a plain language statement. Of the 55 responding participants, 50 consented to take part in the study. The study implementation was overseen by the African Review Panel (ARP) – a lay person steering committee. The ARP was established as part of previous research in this sub-population.^{6,20,21} The study was approved by Deakin University Human Ethics Committee and all data were collected between July and November 2009 (ie over winter or spring).

Procedures and study variables

For those who consented to take part, a questionnaire was administered by either the research assistant or the refugee health nurse to obtain demographic and socio-economic data including: age, gender, country of origin, residence prior to migration, length of stay, and standardized measurements of weight, height and waist and hip circumferences. Appointments were organised for consenting participants to be seen both by the medical practitioner to measure blood pressure and the clinic nurse at Doutta Galla Community Health Services for blood collection. Transport was made available for participants with no transportation means.

Height (measured to the nearest 0.5 cm without shoes using a stadiometer) and weight (recorded to the nearest 50g using the UC-321 scale, A&D Co Ltd, London) were

obtained and used to compute the body mass index (BMI) using the following formula: $\text{weight (kg)}/[\text{height (m)}]^2$. BMI was categorised to obtain the proportion of overweight ($25.0\text{--}29.9 \text{ kgm}^{-2}$) and obesity ($\geq 30 \text{ kgm}^{-2}$).²² Two measurements for the waist (measured to the nearest 0.5 cm; halfway between the lower border of the ribs and the iliac crest in a horizontal plane) and hip (measured to the nearest 0.5 cm; at the widest point over the buttocks) circumference were obtained using a steel measuring tape. For each parameter, if the difference between the two parameters was greater >2 cm, a third measurement was taken. The mean of the two closest measurements was calculated. Waist-to-hip ratio (WHR) was obtained by dividing the waist circumference by the hip-circumference, and categorised according to the proportion of overweight (0.90–0.99 for men and 0.80–0.84 for women) and central obesity (WHR ≥ 1 for men and ≥ 0.85 for women).²²

Blood pressure was measured in a seated position using a standard mercury manometer. The participant was instructed to rest for at least five minutes before the blood pressure measurement was taken. The average of two readings of the blood pressure was used to define hypertension. Hypertension was defined as systolic blood pressure (SBP) ≥ 140 mmHg or diastolic blood pressure (DBP) ≥ 90 mmHg according to the World Health Organization cut-off points,²³ and SBP >130 mmHg or DBP >85 mmHg according to the International Diabetes Federation cut-off points.²⁴

Following an overnight fast between 07.00h and 10.00h, a blood sample for glucose studies, insulin, lipid studies, and 25-OHD was collected with the participant in a seated position. All blood collections were taken by a trained nurse in collaboration with Melbourne Pathology. Specimens were analysed as received in the laboratory, within 12 hours of collection. All samples were analysed by Melbourne Pathology service using Roche/Hitachi Modular® E170 for insulin; Roche/Hitachi Modular® System P for *C-reactive protein* (CRP), high-sensitivity CRP (hs-CRP), high-density lipoprotein cholesterol (HDL-C), and plasma glucose; Siemens Immulite for C-peptide; and DiaSorin LIAISON® for 25-OHD. Low density lipoprotein cholesterol (LDL-C) was calculated using the Friedewald Formula.²⁵ The Homeostasis Model of Assessment (HOMA) was used to evaluate insulin resistance. The insulin resistance score (HOMA-IR) was computed using the following: fasting plasma glucose (mmol/L) multiplied by fasting serum insulin (mU/L) divided by 22.5.²⁶

Vitamin D insufficiency was defined as serum 25-OHD <50 nmol/L.¹⁵ A HOMA-IR cut-off point was used to determine high insulin sensitivity (HOMA-IR <1.93) and low insulin sensitivity/ insulin resistance (HOMA-IR ≥ 1.93).²⁶ Fasting plasma glucose abnormalities were categorized according to the 1998 World Health Organization criteria (normal plasma glucose <6.1 mmol/L, impaired fasting glycaemia 6.1–6.9 mmol/L, and diabetes ≥ 7.0 mmol/L).²⁷ Lipids were classified as abnormal using the following cut-off points: total cholesterol >5.2 mmol/L; LDL-C >3.4 mmol/L; triglyceride >1.7 mmol/L; and HDL-C <1.03 mmol/L.²⁸

Data analysis

All data were analysed using Stata 10.0. (Stata Statistical Software, College Station TX). Given the exploratory nature of the study, data were summarised using descriptive statistics.

RESULTS

Fifty African migrants or refugees participated in the study; however one participant was excluded due to an incomplete data set. All subsequent analysis refer to the final sample of 49 participants (29 men, 20 women). The mean age of the participants was 41.5 years (men: 43.0 years, 95% CI: 37.0-48.9; women: 39.5 years, 95% CI: 33.7-45.2). The participants were relatively new arrivals, with an average length of stay of 6 years (men: 5.7 years, 95% CI: 3.8-7.6 years; women: 6.3 years, 95% CI: 3.3-9.4 years). Participants were predominantly from Ethiopia (39%), Sudan (22%) and Eritrea (20%) and Somalia (10%). The remaining 8% included migrants from Congo, Ghana, Rwanda and Nigeria. The reasons for migration

political/asylum seekers (10%) and educational opportunities (2%).

Table 1 summarises data on vitamin D status, anthropometric outcomes, blood pressure, and high sensitivity CRP. The table shows data collected in the present study in the 'African refugees and migrants' column and a comparison point to other Australian data (when available), from the AusDiab study.^{40,45,46} The prevalence of vitamin D insufficiency (25-OHD levels <50 nmol/L) was 82.8% among males and 95.0% among females. The prevalence of VDI did not vary by gender, age, or length of stay. Based on BMI cut-off points, 85.7% of women and 44.8% of men were overweight or obese. Age was positively correlated with BMI ($r=0.29$, $p=0.043$) and WHR ($r=0.41$, $p=0.003$). However, length stay was neither associated with BMI nor WHR. The prevalence of hypertension was 16% using the World Health Organization cut-off points, and 32% using the International Federation for Diabetes cut-off points. Systolic and diastolic blood pressure did not vary by gender. However, both systolic

Table 1. Obesity, VDI, lipid profile and glucose by gender

Variables	African refugees and migrants			p value	Australian data		
	Female N=20	Male N=29	All N=49		Female	Male	Reference
Anthropometric parameters							
Prevalence of obesity (BMI Categories)							
Healthy: %	14.3	55.2	38.0		-	-	
Overweight: %	57.1	34.5	44.0	0.011	29.9	48.2	40
Obese: %	28.6	10.3	18.0		22.2	19.3	40
BMI kgm-2: mean (SD)	25.0 (4.6)	28.7 (5.8)	26.6 (5.4)	0.007	26.4	27.0	45
Prevalence of central obesity (WHR)							
Healthy: %	33.3	51.7	44.0		-	-	
Overweight: %	14.3	37.9	28.0	0.004	-	-	
Obese: %	52.4	10.3	28.0		-	-	
WHR: mean (SD)	0.85 (0.07)	0.90 (0.09)	0.88 (0.09)	0.013	-	-	
Prevalence 25-OHD (vitamin D) levels							
<50 nmol/L	95.0	82.8	87.8		39	22	46
≥50-<75.0 nmol/L	5.0	13.8	10.2	0.409	39	45	46
≥75.0 nmol/L	0.0	3.5	2.0		22	33	46
25-OHD nmol/L: mean (SD)	22.9 (12.9)	30.4 (20.2)	27.3 (17.8)	0.075	59 (23)	70 (25)	46
Lipid studies(mmol/L): mean (SD)							
Total Cholesterol	4.9 (1.1)	4.7 (0.7)	4.8 (0.9)	0.179	-	-	
LDL-C	3.0 (1.0)	2.9 (0.6)	3.0 (0.8)	0.427	-	-	
HDL-C	1.4 (0.4)	1.2 (0.4)	1.3 (0.4)	0.056	1.6 (0)	1.3 (0)	45
Triglyceride	1.2 (0.5)	1.3 (1.0)	1.3 (0.8)	0.323	1.1 (0)	1.4 (0)	45
Glucose studies: Mean (sd)							
Serum fasting glucose (mmol/L)	4.7 (0.7)	5.3 (0.9)	5.1 (0.9)	0.011	5.2 (0)	5.5 (0)	45
Serum insulin (IU/ml)	10.0 (7.9)	9.5 (6.2)	9.7 (6.9)	0.407	12.1 (6)	12.7 (6)	45
HOMA-IR (Units)	2.1 (1.7)	2.3 (1.6)	2.2 (1.6)	0.355	-	-	
Plasma C-Peptide (pmol/ml)	0.48 (0.23)	0.52 (0.28)	0.5 (0.3)	0.319	-	-	
Blood pressure							
Systolic (mmHg): Mean (sd)	126 (21)	130 (19)	128 (20)	0.220	124(17)	131(18)	45
Diastolic (mmHg): Mean (sd)	78 (12)	80 (12)	79 (12)	0.291	66.2(8)	74.6(12)	45
% SBP≥140 mmHg and DBP≥90 mmHg (WHO)	9.5	20.7	16.0	0.288	-	-	
% SBP≥135 mmHg and DBP≥85 mmHg (IDF)	28.6	34.5	32.0	0.658	-	-	
High sensitivity CRP (hs-CRP) (mg/L): %							
Low (<1.0 mg/L)	5.0	27.6	18.4		-	-	
Moderate (1.0-3.0 mg/L)	40.0	51.7	46.9	0.022	-	-	
High (>3.0 mg/L)	55.0	20.7	34.7		-	-	
(hs-CRP) (mg/L): mean (SD)	4.1 (2.9)	2.5 (2.5)	3.2 (2.8)	0.050	-	-	

included refugee's status (48%), family reunion (40%),

($r=0.48$, $p<0.001$) and diastolic ($r=0.38$, $p<0.01$) blood pressure were positively correlated with age. Similarly,

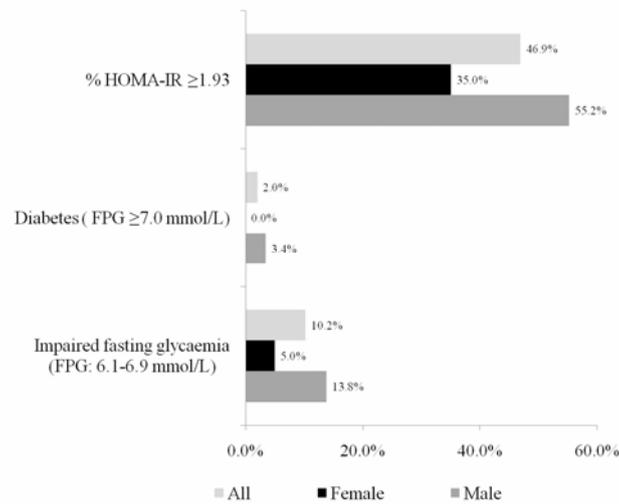


Figure 1. Proportions of African migrant and refugee adults with high fasting glucose or insulin resistance ($\text{HOMA} \geq 7.0 \text{ mmol/L}$)

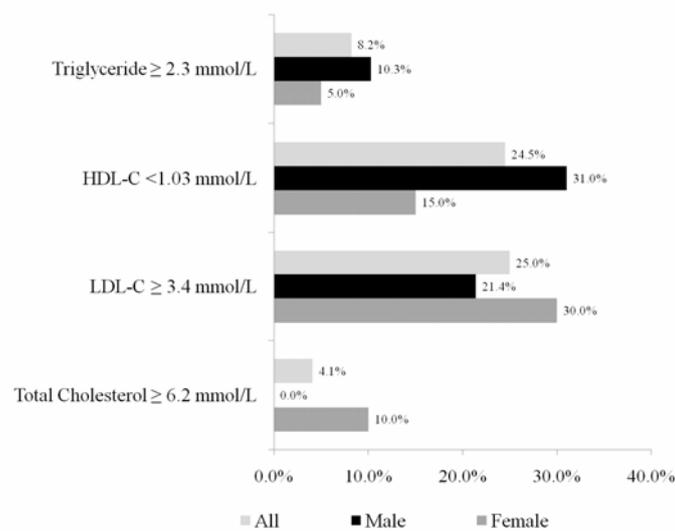


Figure 2. Proportion of African migrant and refugee adults with a lipid threshold above cut-off points used to identify risk for cardiovascular diseases

systolic ($r=0.45$, $p<0.01$) and diastolic ($r=0.46$, $p<0.01$) blood pressure were positively correlated with length of stay. More than one in three participants (34.7%) had high hs-CRP values, and hs-CRP values were higher among women than men ($p<0.05$). Hs-CRP levels were not associated with age or length of stay.

Figure 1 summarises data on fasting plasma glucose and fasting serum insulin. Figure 2 summarises data on lipid profile. Diabetes and insulin resistance were found in 2% and 46.9% of participants respectively, and did not differ by gender or length of stay in Australia. However, fasting glucose was positively associated with age ($r=0.53$, $p<0.001$). Hyperlipidemia was present in this sub-population. Length of stay was positively correlated with total cholesterol ($r=0.33$, $p=0.021$), LDL-C ($r=0.31$, $p=0.0314$), and marginally with triglyceride ($r=0.25$, $p=0.078$), but not associated with HDL-C. None of the lipid parameters were associated with age.

DISCUSSION

This is the first study in Australia to simultaneously measure the risk of the metabolic syndrome and cardiovascular disease among newly arrived migrants and refugees of an SSA background. It should be noted that due to the voluntary nature of participation and small sample

size, the results of this pilot study cannot be generalised to the wider community of SSA migrants living in Australia. Also, given the exploratory nature of the study and small sample size, it was not possible to examine the relationship between vitamin D status and the risk of metabolic syndrome here. Despite these limitations, this study identified a clustering of risk factors for the metabolic syndrome and a high prevalence of VDI amongst participants, suggesting that SSA migrants in Melbourne are at high risk of obesity, impaired glucose and VDI.

We found that more than three quarters of the studied population were vitamin D insufficient. Our findings are consistent with those reported by Skull and colleagues.¹⁵ Current evidence suggests that low vitamin D levels may increase the risk of the metabolic syndrome.²⁹ Some of the many pathological disorders recently been linked with VDI include cancers,^{30,31} ischemic heart disease,^{32,33} impaired immune response,³⁴ increased risk of adiposity, impaired glucose tolerance, impaired lipid metabolism, and elevations in blood pressure.³⁵⁻³⁸ Data from the Third National Health and Nutrition Examination Survey in the USA found that individuals in fourth quartile of serum 25-OHD levels had higher rates of hypertension (odds ratio [OR], 1.30), diabetes mellitus (OR, 1.98), and obe-

sity (OR, 2.29), and higher serum triglyceride levels (OR, 1.47) than those in the first quartile.³⁹

The cardiovascular disease risk of SSA migrants and refugees is increased with obesity, elevated blood lipids and hs-CRP. Despite being relatively recent arrivals (mean length of stay was six years) and predominantly from refugee camps where under-nutrition prevails, our findings indicate that African migrants and refugees gain weight rapidly following migration which is consistent with the current literature.^{6,7} We found a prevalence of overweight or obesity, measured by BMI, of 62% amongst our sample. This figure is slightly higher compared to the prevalence of overweight and obesity among Australian adults (59.8%) reported in the most recent National Health Survey.⁴⁰ However, there was a significant gender differential between our sample and Australian data, with the prevalence of overweight or obesity higher among SSA women than Australian women (85.7% vs. 52.1%) but lower among SSA men than their Australian counterparts (54.8% vs. 67.5%). Sub-Saharan African migrants and refugees in our study had a lower prevalence of diabetes (2.0% vs. 7.5%) but a higher prevalence of impaired fasting glucose (13.8% vs. 5.7%) than their Australian counterparts than that reported in the AusDiab.⁴¹ We found that 25% of participants had LDL-C levels ≥ 3.5 mmol/l and 25% had HDL-C levels < 1.03 mmol/L, cut-off points used to predict heightened risk for heart disease. Ridker,⁴² argues that hs-CRP test along with the lipid profile constitutes the best predictor of the risk for cardiovascular diseases. Using a sample of 27,939 healthy women; the author found that hs-CRP is a stronger predictor of risk than LDL-C, predicts increased risk in subjects without overt hyperlipidemia, and improves prognostic information to risk scoring.⁴²

Policy implications

The observed prevalence of vitamin D insufficiency in this sub-population leads to concerns which warrant increased screening efforts and intervention. These findings also support further work in this area with a much larger, ethnically diverse sample, which would include children and other migrant groups with darker skin pigmentation. Further studies may be needed to examine the relationship between VDI and the risk of diabetes and cardiovascular risk markers among this sub-population. Given the evidence for a beneficial effect of vitamin D in reducing the risk of autoimmune diseases, infections, multiple sclerosis, high blood pressure, T2D, and cardiovascular diseases,^{43,44} it is possible that public health interventions geared toward early identification and treatment on VDI as well as those incorporating vitamin D supplementation, or safe sun exposure to maintain serum 25-OHD levels through healthy lifestyle interventions could significantly reduce the health burden of disease and lead to significant health and economic gains. Increasing vitamin D through healthy lifestyles could include activities such as walking groups in the summer, but care would need to be exercised to minimise the risk of skin cancer. Food fortification with vitamin D could also be useful in raising serum 25-OHD. However, these interventions are unlikely to be sufficient to maintain serum 25-OHD levels throughout the year in this group. Governments accepting large num-

bers of African migrants need to have migration and health policies to inform health programs catering for the health of this sub-populations post-migration, and should consider building primary prevention strategies such as public education into the pre-departure medical assessment and on-arrival information package.

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AUTHOR DISCLOSURES

None declared.

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Short Communication

Prevalence of vitamin D insufficiency and risk factors for type 2 diabetes and cardiovascular disease among African migrant and refugee adults in Melbourne

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澳洲墨爾本之非洲移民及難民的維生素 D 不足與第 2 型糖尿病及心血管疾病風險的盛行率

遷移至工業化國家後，撒哈拉沙漠以南之非洲移民及難民，發生第 2 型糖尿病之風險可謂雪上加霜。這些族群不單是肥胖及第 2 型糖尿病風險增高，更可能由於維生素 D 不足而更惡化。因此，本篇研究目的在描述澳洲墨爾本 20 歲以上之非洲移民及難民，維生素 D 不足、肥胖與第 2 型糖尿病危險因子之人口學變項。資料蒐集自問卷、醫療評估及禁食血液樣本等。結果發現，49 位研究對象之血清平均 25-羥基維生素 D 濃度為 27.3 nmol/L (95% CI: 22.2, 32.4 nmol/L)，其中 88% 之參予者 25-羥基維生素 D 濃度小於 <50 nmol/L。另外也發現研究對象，有第 2 型糖尿病與心血管疾病風險因子的集群現象：研究對象 62% 過重或肥胖、47% 有胰島素抗性(HOMA-IR ≥ 2)、25% 低密度脂蛋白過高 (≥ 3.5 mmol/L)、24.5% 高密度脂蛋白過低(<1.03 mmol/L)、34.6% 總膽固醇過高 (≥ 5.2 mmol/L)、18.2% 三酸甘油酯過高 (≥ 1.7 mmol/L)、16% 患有高血壓。本篇研究顯示，此族群可能處於第 2 型糖尿病與心血管相關疾病風險下，如缺血性心臟病、中風及周邊動脈疾病等。目前急需進行良好規劃的維生素 D 介入並涵蓋生活型態改變的方案。

關鍵字：維生素 D 不足、空腹血糖、非洲移民及難民、胰島素抗性、肥胖