Transactions of the Royal Society of Tropical Medicine and Hygiene (2008) **102**, 645–652

available at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevierhealth.com/journals/trst

Anaemia and malaria in Yanomami communities with differing access to healthcare

P. Grenfell[a], C.I. Fanello[a,*], M. Magris[b], J. Goncalves[b], W.G. Metzger[b,c], S. Vivas-Martínez[b,d], C. Curtis[a], L. Vivas[a]

[a] *London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, UK*
[b] *CAICET (Centro Amazónico para la Investigación y Control de Enfermedades Tropicales ''Simon Bolívar''), Puerto Ayacucho, Amazonas, Venezuela*
[c] *Eberhard Karls Universität Tübingen, Institut für Tropenmedizin, Humanparasitologie, Wilhelmstrasse 27, 72074 Tübingen, Germany*
[d] *Universidad Central de Venezuela, Escuela de Medicina Luis Razetti, Departamento de Medicina Preventiva y Social, Caracas, Venezuela*

Received 5 September 2007; received in revised form 26 February 2008; accepted 26 February 2008
Available online 10 April 2008

KEYWORDS
Anaemia;
Malaria;
Access to healthcare;
Yanomami;
Indigenous populations;
Venezuela

Summary Inequitable access to healthcare has a profound impact on the health of marginalised groups that typically suffer an excess burden of infectious disease morbidity and mortality. The Yanomami are traditionally semi-nomadic people living in widely dispersed communities in Amazonian Venezuela and Brazil. Only communities living in the vicinity of a health post have relatively constant access to healthcare. To monitor the improvement in the development of Yanomami healthcare a cross-sectional survey of 183 individuals was conducted to investigate malaria and anaemia prevalence in communities with constant and intermittent access to healthcare. Demographic and clinical data were collected. Malaria was diagnosed by microscopy and haemoglobin concentration by HemoCue. Prevalence of malaria, anaemia, splenomegaly, fever and diarrhoea were all significantly higher in communities with intermittent access to healthcare (anaemia 80.8% vs. 53.6%, $P<0.001$; malaria 18.2% vs. 6.0%, $P=0.013$; splenomegaly 85.4% vs.12.5%, $P<0.001$; fever 50.5% vs. 28.6%, $P=0.003$; diarrhoea 30.3% vs.10.7% $P=0.001$). Haemoglobin level (10.0 g/dl vs. 11.5 g/dl) was significantly associated with access to healthcare when controlling for age, sex, malaria and splenomegaly ($P=0.01$). These findings indicate a heavy burden of anaemia in both areas and the need for interventions against anaemia and malaria, along with more frequent medical visits to remote areas.

* Corresponding author. Tel.: +44 (0)207 927 2339; fax: +44 (0)207 580 9075.
E-mail address: caterina.fanello@lshtm.ac.uk (C.I. Fanello)

0035-9203/$ – see front matter © 2008 Royal Society of Tropical Medicine and Hygiene. Published by Elsevier Ltd. All rights reserved.
doi:10.1016/j.trstmh.2008.02.021

1. Introduction

Inequitable access to healthcare has a profound impact on the health of marginalised groups worldwide. Coupled with low income and poor sanitation, these populations typically suffer an excess burden of infectious disease morbidity and mortality. Undernutrition is particularly common among indigenous groups; recent research in four Latin American countries has linked malnutrition and stunting among indigenous children to a lack of maternal education, road accessibility and access to healthcare (Buitron et al., 2004; Larrea and Freire, 2002; Larrea and Kawachi, 2005). However, general information on the current state of health of indigenous populations in Latin America is sparse and based on disaggregated national data (Montenegro and Stephens, 2006). In Venezuela, although healthcare is free and access has recently improved (PAHO, 2006), barriers remain, particularly among indigenous populations in remote areas. One of the largest and least culturally assimilated ethnic groups is the Yanomami, a traditionally semi-nomadic people inhabiting an extensive geographic area spanning the Venezuelan–Brazilian border (Lizot, 1988). In Venezuela the majority of Yanomami live in widely dispersed communities where healthcare is delivered through basic primary health centres, each attended by a medical doctor, a community health worker and a microscopist. As such, communities living in the vicinity of a health post have relatively constant access to healthcare whilst more remote populations depend upon the intermittent visits of a mobile medical team. Communities out of reach of these medical teams have virtually no access to healthcare. Although Yanomami beliefs relating to health and well-being differ greatly from western views and traditional medicine remains strongly relied upon, medical attention may be sought for the treatment of infectious diseases.

Prior research has documented an extremely high prevalence of anaemia among Yanomami communities of 91% (Perez Mato, 1998). Anaemia can have serious long-term health effects including reduced cognitive development (Grantham-McGregor and Ani, 2001; Lozoff et al., 2000), growth (Lawless et al., 1994), immune function (Oppenheimer, 2001) and physical endurance, whilst severe anaemia is associated with increased mortality (WHO, 2001). The aetiology of anaemia is multifactorial and risk factors often occur concurrently, such as nutritional deficiencies (particularly iron), malaria and infection with other pathogens, e.g. hookworm, bacteraemia and HIV, as well as predisposing genetic disorders (Crawley, 2004; Schellenberg et al., 2003; Shamah-Levy et al., 2003). Recurrent episodes of malaria contribute to the development of anaemia and severe anaemia through haemolysis of parasitized red blood cells, dyserythropoeisis (Giribaldi et al., 2004; Layez et al., 2005) and accelerated clearance of uninfected erythrocytes (Evans et al., 2006). Malaria is endemic to the Amazon basin and a considerable cause of morbidity in Yanomami communities, recent reports indicating a prevalence of 14–24% (Marcano et al., 2004; Perez Mato, 1998). Whilst *Plasmodium vivax* is the predominant cause of malaria in this region, *P. falciparum* is responsible for about 16% of cases (Ministerio del Poder Popular para la Salud, 2007).

The aim of this study was to determine the prevalence of anaemia and malaria among Yanomami communities with differing access to healthcare. As part of national health reforms, the Venezuelan Ministry of Health is currently developing a health plan specific to the Yanomami population. By addressing the relationship between access to healthcare and community anaemia prevalence, the results of the study may provide a suitable indicator for monitoring improvement during the development and implementation of the Yanomami health plan, particularly in relation to the equitable provision of health services to the Yanomami population.

2. Methods

2.1. Study area and population

This study was conducted in the Alto Orinoco region of south Venezuela, an area of tropical perennial forest intersected by a dense river system. In the absence of roads all travel is by light aircraft, motor boat or canoe. The predominantly Yanomami population inhabits geographically dispersed communities (INE, 2001). The study population was drawn from 11 communities in two areas with differing access to healthcare. Five communities were categorised as having constant access to healthcare (Ocamo area), being located within one km (20 min by boat) of a primary health post attended by a resident physician, a community health worker and two trained microscopists. The remaining six communities were assessed as having intermittent access to healthcare, being located within a one-to-four hour motorboat journey of the health post (Alto Ocamo area). These communities are visited by a medical team approximately fortnightly.

2.2. Study design and methodology

In July 2005, 183 Yanomami individuals were randomly selected to participate in a cross-sectional survey. In the Ocamo area, a recent census was provided, which was updated by the community health worker. In Alto Ocamo communities, a census was taken before conducting the survey due to a lack of available demographic information. The study population was divided into three age groups (0–4 years, 5–14 years and $\geq$15 years), a stratification commonly used in malaria and anaemia studies since these groups often differ in terms of malaria immunity and haemoglobin level. Age is typically not documented among Yanomami and was therefore estimated by locally experienced medical staff. Sample size calculations were based upon data previously collected in the region (Kirkwood and Sterne, 2003; Magris et al., 2007) to allow detection of a 1 g/dl difference in haemoglobin concentration between the two areas, within each age group (90% power at 0.05 level of significance). Although demographic and logistical constraints prevented strict adherence to these estimates, sample sizes in each age group were considered sufficient to detect this difference.