

ESTIMATION OF PARAMETERS IN A CLOSED PYGMY POPULATION IN CAMEROON*†

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Abstract

Inspired by Kouakep [16], we consider in this note a wellposed model with differential susceptibility and infectivity adding continuous age structure to an ODE model for a “Baka” pygmy group in the East of Cameroon (Africa). Assuming a very low contribution of carriers to infection compared to acute infection, we estimate a probability $p(a)$ (to develop symptomatic Hepatitis B state at age a) and acute carriers’ transmission rate. The value $R_0 = 2.67 > 1$ of the basic reproduction number estimated from data in the east of Cameroon confirms that HBV is endemic in the Baka pygmy group.

Keywords Hepatitis B; parameters estimation; Baka pygmy group; Cameroon

2000 Mathematics Subject Classification 35Q92; 92D30; 92D25

1 Introduction

Hepatitis B is endemic in Africa [23]. There are few data updated on epidemiology of Hepatitis B in Africa, especially in Cameroon [17, 21, 25]. But common measures and surveys on clinical cases show that average prevalence in Cameroon is almost 10% and the average of prevalence for the three pygmy groups (the Baka, the Bakola and the Bedzan.) studied by Foupouapouognigni et al. [12] is around 11%. Since 20,000 years, the Pygmies have lived in a forest environment in Cameroon prominently as hunter-gatherers (Verdu et al. [20]).

HBV (Hepatitis B Virus) epidemiology in Cameroon social context briefly presented:

*This work was supported by AASRG/AIMS/IRDC and GDM-MIAP student project team.

†Manuscript received November 2, 2016

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- 1) Professor Njoya Oudou, a specialist of Hepatitis diseases in [25] argues that 10 percent [3,17,25] of Cameroonians suffer from hepatitis B and need around USD 800 per month [5] for the treatment, even vaccination costs USD 50 per vaccinated individual [5]. Total population of Cameroon is around 22 millions [21,24].
- 2) The relative importance of mother-child transmission of HBV (Hepatitis B virus) in Cameroon is not well known [17].
- 3) Treatments available for chronic hepatitis (not the acute one which is incurable) such as Interferon-alpha, Lamivudine, Adefovir or Entecavir [18] are expensive. Vaccine since 1981 [3,18] GenHevac B protects 98% at least 10 years.
- 4) The rate of superinfection with other diseases such as hepatitis D is 25% [17,18]. World Hepatitis day is held every year in July.
- 5) The maximal life span (years) is 51 years [21] and the birth rate is 32.49 per 1000 [15] in Cameroon.

Our main result is to practically estimate HBV prevalences, the probability $p(a)$ (to develop symptomatic Hepatitis B state at age a) and acute carriers' transmission rate β_i . According to WHO [23] and Bonzi et al. [3], chronic carriers (most of time asymptomatic) have a low infectious rate. As a consequence in this work we assume that $\beta_e \approx 0$ compared with β_i . The work is organized as follows. In Section 2, we present the model and estimate the parameters with least squares. Here we perform numerical simulations. Later in Section 3 we present results through evaluated prevalences and graphics. Finally we give a discussion in Section 4.

2 Model, Parameters Estimations and Numerical Simulations

2.1 Presentation of Cameroonian pygmy groups useful for our simulations

We now consider the tree pygmies seen as almost globally closed populations with 44700 to 56000 individuals studied in Foupouapouognigni Y. et al. [12], that is, the Baka group is the largest one (40,000 to 45,000 individuals), and its distribution overlaps the two administrative regions of the south and the east of Cameroon; the Bakola pygmies are the next most populous group (4,000 to 5,000 individuals), mostly located in the western part of the southern region in the Atlantic Ocean division; the Bedzan group is the smallest one (700 to 1,000 individuals) and is located in the northern part of the central region. According to Foupouapouognigni [12], HBV surface antigen (HBsAg) was screened by a third-generation EIA (Monolisa AgHBs