

Characteristics of the Epidemiological Transition from 1990 to 2020 in Côte d'Ivoire

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Abstract

Background: Since it was theorised by Abdel Omran in 1971, the epidemiological transition has been well documented in Latin America, Asia and even increasingly in Africa south of the Sahara. According to this theory, sub-Saharan Africa is in the first phase of development corresponding to the “age of plague and famine”. Given the health statistics currently available, more and more low- and middle-income countries, including those in sub-Saharan Africa, are experiencing an increase in mortality and the economic impact associated with non-communicable diseases. Côte d'Ivoire is one of the countries in sub-Saharan Africa where non-communicable diseases are currently on the rise. Despite the significant changes observed over the last decades, few studies have been carried out on the epidemiological transition in Côte d'Ivoire. It therefore seemed necessary to examine the changes in patterns of disease occurrence and causes of death in Côte d'Ivoire. **Objectives:** This work aimed to determine the reality of the epidemiological transition in Côte d'Ivoire and characterize its facies from 1990 to 2020. **Methods:** A literature review was carried out using PubMed, Medline, Google Scholar, Google, institutional websites (WHO, World Bank), university library websites and institutional reports from Côte d'Ivoire. The indicators sought were mortality, morbidity, life expectancy and fertility. **Results:** Mortality fell overall from 13.88‰ to 9.70‰, with variations linked to cyclical situations. Life expectancy rose by 52.6 to 59.03 years, although it is still below 60. Fertility has fallen from 6.3 to 4.5 children. There is a general downward trend in morbidity due to communicable diseases between 2009 and 2019, followed by an increase in non-communicable diseases. **Conclusion:** Côte d'Ivoire is undergoing an original and

complex epidemiological transition that needs to be taken into account in health policies and strategies.

Keywords

Epidemiological Transition, Omran's Theory of Epidemiological Transition, Communicable Diseases, Non-Communicable Diseases, Côte d'Ivoire

1. Introduction

The lifespan of the world's population has increased from 52 years in 1960 to 72 years in 2020, with disparities between regions [1]. Increases in longevity have been accompanied by a historical shift in the specific causes of mortality risk in human populations [2]. These transformations in trends in the occurrence of disease and the causes of death observed in Western Europe and North America were described by Omran Abdel in 1971 as an "epidemiological transition" [2] [3].

Omran argues that, during the epidemiological transition, there is a long-term shift in patterns of mortality and disease in which pandemics of (communicable) infections are gradually replaced by degenerative and artificial diseases as the main form of morbidity and the main cause of death [4].

In his theory of the epidemiological transition, which focuses on the mortality component of the demographic transition [5], Omran initially describes three epidemiological ages: the "age of plague and famine", during which mortality is very high. It is subject to abrupt variations due mainly to infectious and parasitic diseases and deficiency diseases; the "age of receding pandemics", when mortality falls, epidemics become rarer and endemic infectious diseases recede; the "age of degenerative and societal diseases", when mortality tends to stabilize, as does the increase in life expectancy, which had previously progressed very rapidly [6].

Omran then described three possible models for expressing the epidemiological transition: 1) *the classical or Western model*, describing the transition from a high mortality and birth rate to a low mortality and birth rate that accompanied the modernisation and democratisation of most Western societies; 2) *the accelerated model*, in which the characteristic phases of the epidemiological transition are short-lived and progress is rapid, particularly in terms of mortality; 3) *the contemporary or delayed model*, dedicated to developing countries. There was a timid decline in mortality, especially after the Second World War, but this was not followed by a global change in economic, political and cultural systems [4].

Since its theorization by Abdel Omran in 1971, the epidemiological transition has been well documented in Latin America, Asia and even increasingly in Africa south of the Sahara [7] [8].

According to this theory, sub-Saharan Africa is in the first phase of development, corresponding to the "*age of pestilence and famine*" [9]. However, in view of the health statistics currently available, an increasing number of low- and

middle-income countries, including underdeveloped countries in sub-Saharan Africa, are experiencing rising mortality and economic repercussions from non-communicable diseases [10]-[14]. According to current projections, the greatest increase in deaths from non-communicable diseases is in Africa. On this African continent, the meteoric rise in these non-communicable diseases adds to the pre-existing burden of infectious diseases [15].

Côte d'Ivoire is one of the countries in sub-Saharan Africa where non-communicable diseases are currently on the rise [16]. The question we are therefore asking is whether there really is an epidemiological transition in Côte d'Ivoire, and what are its characteristics? Despite the significant changes observed in recent decades, few studies have been carried out on the epidemiological transition in Côte d'Ivoire. To answer these questions, it seems necessary to examine the transformations in disease occurrence patterns and causes of death in Côte d'Ivoire. Thus, this work aimed to determine the reality of the epidemiological transition in Côte d'Ivoire and to characterize its facies from 1990 to 2020.

2. Methods

A literature review was carried out on the epidemiological transition in Côte d'Ivoire during the period 1990-2020. Scientific documents (articles, reports, communications, etc.) were first searched in online databases, including PubMed, Medline, Google Scholar and Google institutional sites (WHO, World Bank), online university libraries (Institute for Health Measurement and Evaluation at the University of Washington in the United States and Perspective Monde at the University of Sherbrooke in Canada).

A combination of the following keywords with Boolean operators was used for this search: “epidemiological transition*” OR “health transition*” OR “non-transmissible diseases*” OR “fertility* mortality*” OR “birth rate*” “life expectancy*” AND “Côte d'Ivoire” OR “Sub-Saharan Africa*” OR “West Africa*”. The French version of these keywords is as follows: “transition épidémiologique*” OR “transition sanitaire*” OR “maladies non transmissibles*” OR “fécondité* mortalité*” OR “natalité*” “espérance de vie*” AND “Côte d'Ivoire” OR “Afrique subsaharienne*” OR “Afrique de l'Ouest*”.

The online keyword search yielded thousands of articles, which were divided into three categories. The first group (A) consisted of 19 relevant articles, the second group (B) consisted of 55 less relevant articles, and the final group (C) consisted of all out-of-frame articles. Of the 19 relevant articles, the five most relevant were identified. These five articles were then searched for references and related citations.

With regard to the physical documents consulted, the first group came from the Institut National de la Statistique de Côte d'Ivoire: Volume IV of the results of the Recensement Général de la Population et de l'Habitat (RGPH) 1998. The second group of documents consulted came from the Ministry of Health and Public Hygiene. These are the *Annuaire des Statistiques Sanitaires* (ASS) for the years 2001-2006, 2007-2008; the *Rapports Annuels sur la Situation Sanitaire* (RASS) for 2010-

2012, 2013, 2015, 2016, 2017, 2018 and 2019, followed by the Enquêtes Démographiques et de Santé (EDS) reports for 1994, 1998, 2011-2012. The indicators sought are mortality, morbidity, life expectancy at birth and fertility.

3. Results

3.1. Mortality Trends

The interest of studying mortality lies in its close relationship with the level of fertility, which is constantly changing [17].

3.1.1. Overall Mortality

An examination of mortality trends in Côte d'Ivoire shows that the crude mortality rate was high (13.88‰) in 1990. This rise in mortality continued until 2001, when it peaked at 15.04‰. From 2002, mortality begins a steady decline (15.02‰) to reach a rate of 9.70‰ in 2020 (Figure 1). Mortality is falling overall, but has experienced variations over time that are linked to cyclical situations.

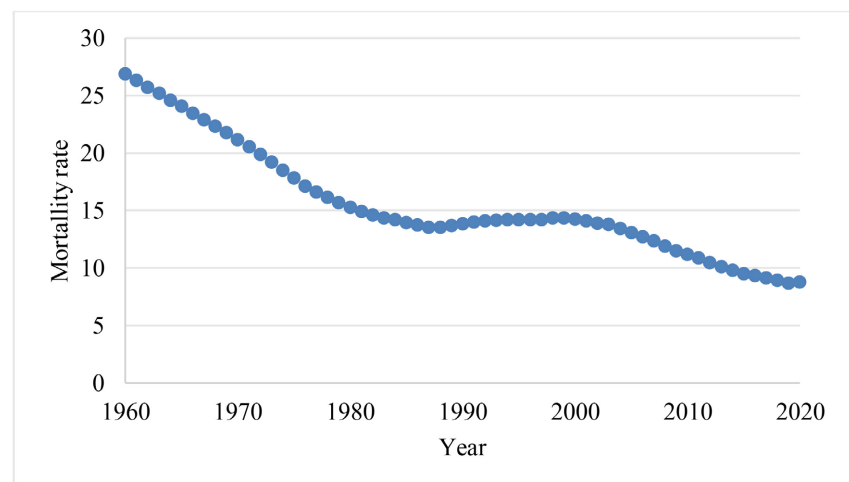


Figure 1. Crude mortality rate (per 1000 inhabitants), Côte d'Ivoire, 1960-2020 [18]. Perspective monde, date de consultation: 09/07/2022, source: Banque mondiale.

3.1.2. Infant Mortality

As with overall mortality, there is the same general downward trend in mortality for children under 5 and under one year of age. From 1990 to 2020, infant mortality in these two age categories will evolve in almost identical fashion. Indeed, mortality rates for these two age categories first experienced a slight increase respectively from 142.6‰ in 1990 to 148‰ in 1995 and from 93.4‰ in 1990 to 98‰ in 1995. Thereafter, mortality rates begin a steady decline until 2019, with the rate (72.6‰) in the under-5s higher than that in the under-1s (47.8‰). However, the variation between the under-5 and under-1 mortality rates goes from double in 1990 (142.6‰ vs 93.4‰) to half in 2019 (72.6‰ vs 47.8‰). This variation clearly shows that under-5 mortality has fallen twice as much as under-1 mortality over the three-decade period considered (Figure 2).

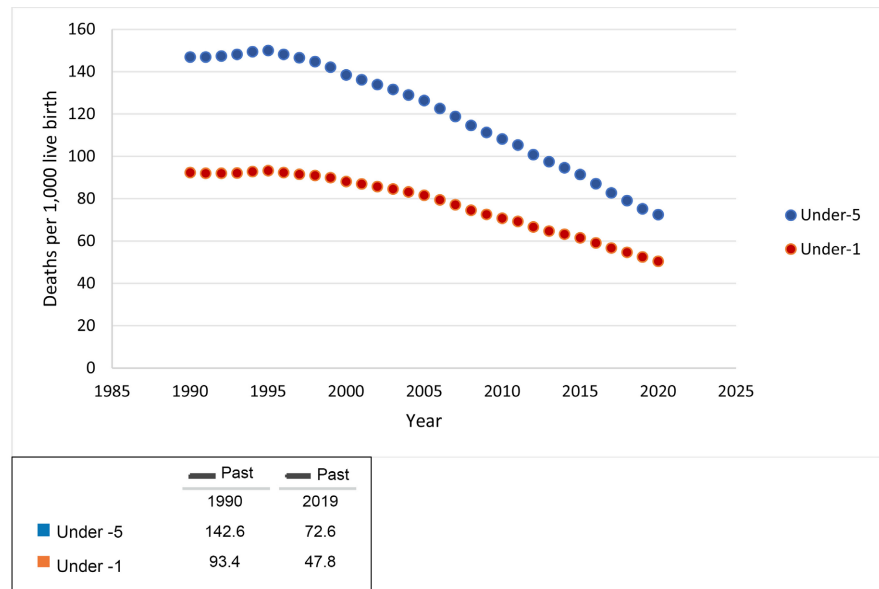


Figure 2. Trends in infant mortality for children under 5 and children under 1, 1990-2019 [19].

3.2. Life Expectancy at Birth

Observation of life expectancy at birth shows a general upward trend, albeit with variations over time. From 1990 to 2020, the life expectancy curve shows two main periods. The first period runs from 1990 to 2002 and corresponds to a phase of steady decline, with life expectancy falling from 52.6 years to 49.48 years. From 2003 onwards (49.57 years), life expectancy will start to rise gradually, reaching its current level of 59.03 years in 2020. Despite this general upward trend, life expectancy in Côte d'Ivoire is still below the age of 60 (**Figure 3**).

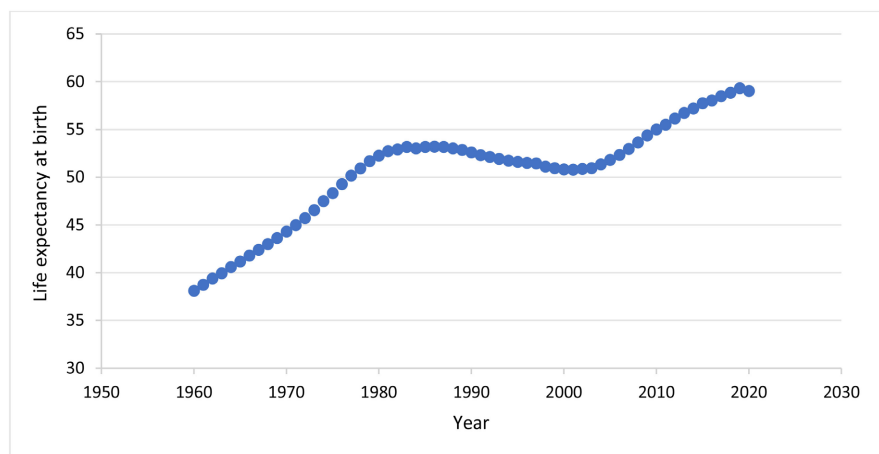


Figure 3. Life expectancy at birth (years), Côte d'Ivoire, 1960-2020 [20]. Perspective monde, date de consultation: 24/04/2023, source: Banque mondiale.

3.3. Fertility Trends

The fertility rate in Cote d'Ivoire fell steadily from 1990 to 2020. Indeed, the Total

Fertility Rate (TFR), which was estimated at 6.3 children in 1990, fell to 5.7 children in 1994 [21], then to 5.2 children in 1998-1999 [22], reaching 5.0 children in 2011-2012. The same downward trend continues after 2012, reaching a TFR of 4.5 children in 2020 [23] (Figure 4).

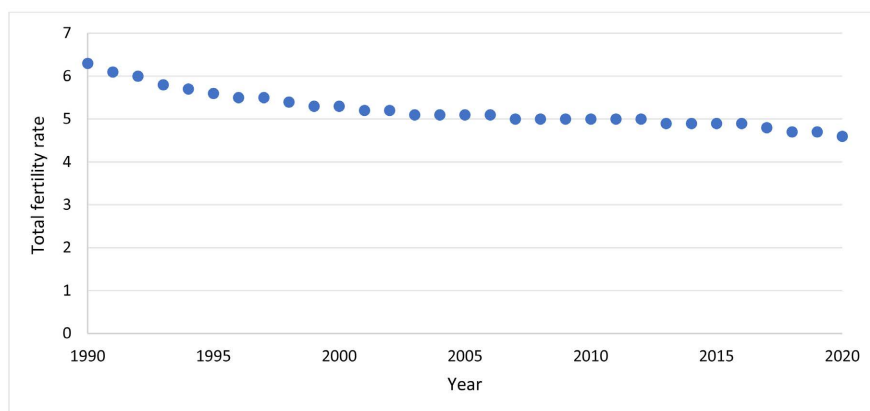


Figure 4. Fertility rate (births per woman), Côte d'Ivoire 1960 to 2020 [24]. Perspective monde, date de consultation: 24/04/2023, source: Banque mondiale.

3.4. Morbidity Trends

Morbidity in Côte d'Ivoire is characterized by the coexistence of infectious, maternal, neonatal and nutritional diseases with non-communicable diseases.

An examination of the top 10 causes of death between 2009 and 2019 shows that six out of ten causes are represented by communicable diseases, the incidence of which is generally declining in varying proportions between 2009 and 2019. For example, morbidity fell for neonatal disorders (−14.8%), malaria (−29.4%), lower respiratory tract infections (−16.8%), HIV/AIDS (−59.7%), diarrhoeal diseases (−29.0%) and tuberculosis (−9.6%) (Figure 5).

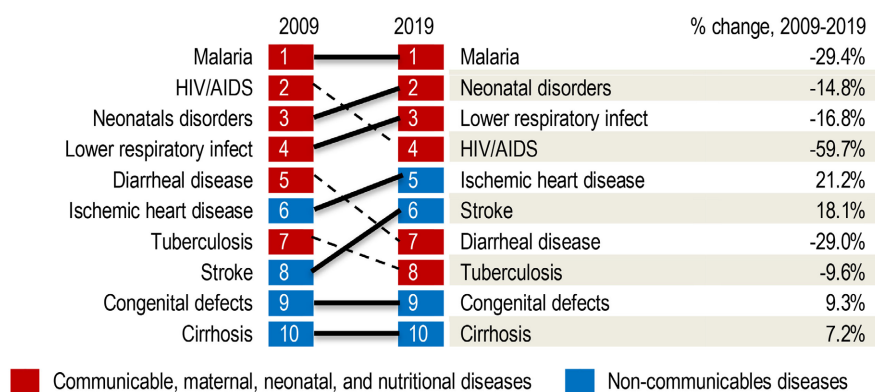


Figure 5. Top 10 causes of total number of deaths in 2019 and percent change 2009-2019, all ages combined, Côte d'Ivoire [19].

As for the other four of the ten causes, they are due to NCDs whose incidence has increased in recent years. For example, there has been an increase in strokes (+18.1%), ischemic heart disease (+21.2%) and cirrhosis (+7.2%) (Figure 5). For

2019, we note that diabetes has increased dramatically [19].

This significant increase in the share of NCDs in the ten leading causes of death and disability in recent years is linked to the increase in the frequency of their metabolic, dietary and behavioural risk factors (**Figure 6**) [19].

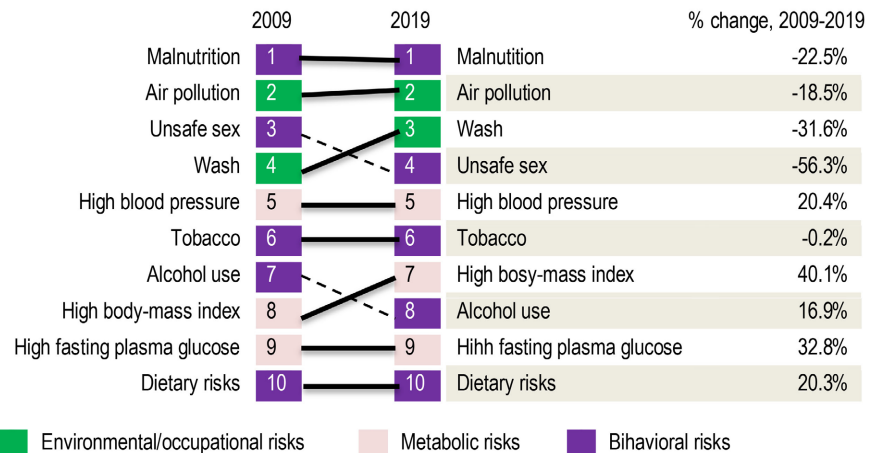


Figure 6. Combination of risk factors that cause the most death and disability in 2019 and percent change 2009-2019, all ages combined, Côte d'Ivoire [19].

4. Discussion

The epidemiological transition is one aspect of the “demographic transition” developed by Notestein to describe the transition to lower birth and death rates at the human population level [5]. The epidemiological transition begins with the major premise that mortality is a fundamental factor in population dynamics [6].

Observation of the epidemiological situation in Côte d'Ivoire shows that infectious diseases and epidemics are still frequent, as are maternal and neonatal diseases. This epidemiology is reflected in still high general and infant mortality, with respective rates of 9.7‰ for the whole, 72.6‰ for the under-5s and 47.8‰ for the under-1s in 2020 (**Figure 1** and **Figure 2**). The rise in mortality observed from 1990 to 2000 was the result of the socio-economic crisis of the 1980s, with its attendant structural adjustments, which called into question the downward trend that had begun in the years of independence [17]. As mortality is highly sensitive to socio-economic conditions, and as the socio-economic and health environment deteriorated, it increased for exactly a decade [17].

In view of the high frequency of epidemics and the presence of numerous endemic infectious diseases, the epidemiological situation in Côte d'Ivoire would be in the era of plague and famine as described by Omran in his 1971 theory [9].

Côte d'Ivoire's epidemiological picture shows that communicable infectious diseases are still rife. However, these transmissible infectious diseases are on the decline. Improved living conditions and health progress since independence, and particularly in recent decades, have led to a significant reduction in the incidence of many communicable diseases and a downward trend in general mortality [17]. This is illustrated, for example, by the decline in malaria (−29.4%), neonatal

infections (−13%), respiratory infections (−16.8%), diarrhoeal diseases (−29%) and tuberculosis (−15%).

Early mortality has not yet disappeared, but it has nevertheless fallen sharply. Infant mortality has fallen from 142.6‰ in 1990 to 72.6‰ in 2020 for children under the age of 5, and from 93.4‰ in 1990 to 47.8‰ for children under the age of 1 in 2020. The use of vaccines has also led to a decline in diseases such as small-pox, polio, tuberculosis and many other vaccine-preventable conditions [9].

Although still high, fertility has fallen relatively significantly, from 6.4 children in 1990 to 4.54 children in 2020. This steady downward trend between 1990 and 2020 could be explained by the results of birth control policies through family planning, combined with the gradual enrolment of girls in school and improved social and health conditions for mothers and their children [21].

Moreover, more than half of the Ivorian population now lives in urban areas. From 39.34% in 1990, the urban population has risen to 51.71% in 2020. This galloping urbanization, accompanied by immigration, adds to the decline in premature mortality and fertility to form a set of factors characteristic of the epidemiological transition [24].

Given the fall in general and infant mortality, fertility and the decline in endemic infectious diseases and epidemics, the epidemiological transition in Côte d'Ivoire can also be classified as an era of regression of plagues and famines.

In our study, we observed that life expectancy in Côte d'Ivoire is increasing overall and has almost reached the age of 60. This increase in life expectancy can be explained by the improvement in socio-economic and health conditions, which has led to a reduction in mortality [25]. Indeed, changes in life expectancy appear to reflect changes in mortality [18].

While communicable diseases decrease, the last few decades have seen a meteoric rise in chronic diseases linked to diet, a sedentary lifestyle and pollution. Strokes (+13%), ischemic heart disease (+18.1%) and cirrhosis (+7.2%) have all increased. In recent years, diabetes has risen to 9th place among the top 10 causes of death and disability in Côte d'Ivoire [19]. This significant increase in the share of non-communicable diseases in the top ten causes of death and disability in recent years can be explained by the increase in the frequency of their risk factors [26]. Indeed, analysis of the combination of the top 10 risk factors causing the most death and disability reveals a sharp increase in risk factors for non-communicable diseases [19]. It is true that certain factors, such as malnutrition (−22.5%), air pollution (−18.5%) and smoking (−0.2%), have seen a decline in terms of variation between 2009 and 2019. Despite the sharp fall (−22.5%) between 2009 and 2019, malnutrition remains the leading risk factor for morbidity and death in Côte d'Ivoire. In contrast, risk factors such as high body mass index, fasting hyperglycaemia, high blood pressure, dietary risk and alcohol consumption have increased by (+40.1%), (+32.8%), (+20.4%), (+20.3%) and (+16.9%) respectively over the last few decades [19]. With the decline in communicable diseases, the emergence of NCDs and longer life expectancy, the epidemiological transition in

Côte d'Ivoire also presents the characteristics of the era of chronic degenerative diseases and diseases of society described by Omran [6].

In the light of the above, we can conclude that we are indeed witnessing an epidemiological transition in Côte d'Ivoire. And the factors associated with the first phase of this epidemiological transition (the era of plagues and famines) are the high frequency of infectious diseases, epidemics, maternal and neonatal diseases, nutritional deficiencies and high general and infant mortality rates.

For the second phase of the epidemiological transition (the era of the decline of plagues and famines), these are the epidemiological changes that occurred through the fall in general and infant mortality, the significant decline in communicable infectious diseases and the relatively significant fall in fertility.

Finally, the factors associated with the third phase of the epidemiological transition (the era of chronic degenerative and societal diseases) are the observed decline in communicable diseases, the increase in life expectancy and the rise in chronic non-communicable diseases.

However, this epidemiological transition in Côte d'Ivoire is original and complex. The meteoric rise of NCDs has added to the pre-existing burden of infectious diseases [15]. This explains why most African populations live with a continuous co-occurrence of diseases of infectious and non-infectious origin, with varying degrees of chronicity [2]. The coexistence of communicable, nutritional and perinatal diseases with non-communicable diseases has been described as a “double burden of morbidity and mortality” [27] [28]. Compared to Europe and North America, the epidemiological picture of Africa in general, and of Côte d'Ivoire in particular, is original in that it presents a double burden for the populations of the country [29]. The situation of accumulation of pathologies observed in this country appears to certain authors as a complex and incomplete form of epidemiological transition [30]. Unlike Omran's contemporary or delayed model [4], the expression of the epidemiological transition in Côte d'Ivoire straddles the three epidemiological ages described by Omran. The expression models proposed in Omran's theory are therefore incomplete and unsuitable for characterizing the epidemiological situation in Côte d'Ivoire.

Thus, the characteristics of the epidemiological transition in Côte d'Ivoire confirm, once again, the criticisms expressed by certain authors on the predictive nature of Omran's theory for developing countries. Agyei-Mensah and de-Graft Atkins (2010) pointed out that the process of sequential steps proposed in the Omran model does not reflect epidemiological changes in some societies, particularly in the African context [31]. For other authors, the concept of epidemiological transition as an adequate framework for describing and understanding the evolution of population health in developing countries in general, and in Africa in particular, is inadequate [32]-[35]. Yusuf *et al.* (2001) and Kuate Defo (2014) argue that the concept of epidemiological transition as a descriptive and predictive model is incomplete or irrelevant in tracing the experiences and perspectives of population and health in the African context. Furthermore, health, disease and mortality

processes have unfolded in African countries in diverse political, cultural, socio-economic, demographic, institutional and structural transformation environments over the past 60 years [2] [36]. Thus, predictions and descriptions of epidemiological changes concerning Africa south of the Sahara and the explanation of the increase in non-communicable diseases are essentially extrapolations of the experience and history of industrialized countries, whereas the Sub-Saharan African countries have a different history and socio-economic development process [37].

5. Conclusion

Our study showed that the significant changes in the epidemiological profile reflect the epidemiological transition underway in Côte d'Ivoire. The expression of this epidemiological transition does not correspond to the models proposed and described in Omran's theory of 1971. It is a complex and incomplete form of double-burden epidemiological transition, where non-communicable diseases are added to the pre-existing burden of infectious pathologies.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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