

# Gestational Malaria and Living Conditions in Turbo, Colombia

*Jaime Carmona-Fonseca, María Mercedes Arias V., Adriana Correa B., and Maritza Lemos*

## Abstract

**Background:** The study of gestational malaria has focused on biomedical aspects and ignored social aspects.

**Objectives:** To describe the socio-economic characteristics of families with and without gestational malaria in Turbo (Antioquia, Colombia).

**Methodology:** Descriptive study using socio-economic surveys in a random sample of 84 mothers/families.

**Results:** There was no statistically significant differences between pregnant women with and without gestational malaria in terms of the characteristics examined. The mothers were between ages 23 ±5 years, 64% of peasant origin, 14% illiterate, 61% educated to primary school level, 17% with knowledge of a particular trade. Among the 23 % of mothers doing paid work all were doing marginal work in all cases; 63% were direct operators and 37% were administrators/managers; average monthly income 166,000 pesos (USD \$83). Spouses/partners worked as follows: 52% miscellaneous occupations, 17% in farming; average monthly income 320,000 pesos (USD \$160). Complete nuclear families were found in 77% of cases and averaged 5.4 members each. Housing: 63% family-owned; 2.5 sleepers/room; 2.5 sleepers/mosquito net. There was no anti-mosquito activity in 62% of families.

**Corresponding Author:** Jaime Carmona-Fonseca MD, MSc, Grupo Salud y Comunidad-César Uribe Piedrahíta (Universidad de Antioquia); Carrera 51D Nro. 62-29. Medellín, Colombia. Telephone 219 60 25, fax 219 60 51; Email: [jaimecarmonaf@hotmail.com](mailto:jaimecarmonaf@hotmail.com)

María Mercedes Arias V. PhD, Grupo de Políticas y Servicios de Salud (Universidad de Antioquia), Calle 62 Nro. 52-59, torre 1, piso 3. Medellín, Colombia  
Adriana Correa B. MSc Grupo Salud y Comunidad-César Uribe Piedrahíta (Universidad de Antioquia)  
Maritza Lemos C. Grupo Salud y Comunidad-César Uribe Piedrahíta (Universidad de Antioquia)

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Drinking/cooking water: 76% use rainfall as sole or combined source. Connection to sewage system: 59%. Home environment: 71% with vegetation and flowing/stagnant water. Waste: 26% dumped on the ground/in the water.

**Conclusions:** The living conditions of these families are less than satisfactory. Mothers are financially dependent (80%) and those with paid employment (20%) work in marginal activities. The home environment and families' antimalarial practices strongly favor the presence of malaria.

**Key words:** malaria, pregnancy, living conditions, social conditions, family, Urabá, Colombia

## Introduction

The various analytic approaches to understanding the social dimensions of the health/disease process relate the distribution, frequency and severity of disease to different measures of social inequalities among individuals and groups.<sup>1</sup> There are very few Latin American studies on gestational, placental, and congenital malaria and their associated problems.<sup>2</sup> In areas of low endemicity, congenital malaria is more frequent than in those of high endemicity; however, most of this data comes from Africa where the prevalence is 8 to 47%.<sup>3-5</sup>

Malaria occurs in the poorest sections of the population, those who receive the least health care and suffer the worst effects of the disease in terms of lost earnings. Among the poor, malaria has a bigger impact on women due to their greater social vulnerability. Because they have limited access to those goods and services they need to care for themselves, women are more likely to get sick, particularly when they are pregnant.<sup>6-8</sup>

Women's disadvantage stems from social determinants which compound gender inequity with class and ethnic inequities.<sup>9</sup> In most countries women fare much worse off on all socio-economic indicators including access to productive and human/social capital resources. They work harder, eat less, and have fewer social support services.<sup>10</sup> Poor and rural women have lower levels of education and

access to health services; they have higher perinatal mortality.<sup>11</sup> A higher level of education is associated with greater use of medical services and contributes to a better understanding of the information provided in pre-natal checks, better food practices, and greater recognition of the signs of danger during pregnancy.<sup>11</sup>

In Colombia in 2005 12% of pregnant women in rural areas received no perinatal care. In this group 26% had received little or no education and 16% earned less than the current legal minimum wage.; 23-33% did not give birth in a health center.<sup>13,14</sup>

In summary, living conditions are the fundamental determinants of the health of women and their children; this is particularly true for women living in malarial zones and is especially so for pregnant women with malaria. These conditions form the material reality of daily life for individuals and families. They are determined by social dynamics and mediated by the process of social reproduction. The health/disease process is dynamic, dialectic, and historical. To understand it requires various levels of explanation, interrelation, and determination.<sup>15,16</sup>

Family poverty is central to the genesis of health/disease. Greater maternal and perinatal morbidity and mortality are seen in poorer individuals, families, and social classes/groups.<sup>17,18</sup> Poverty itself is the result of the social organization of production, distribution, and consumption of goods and services. These processes are either based on social equity, thus promoting equality, or they are based on inequity and thus produce inequality.<sup>9</sup> These structural social processes—be they equitable or not—determine (i.e. cause) health/disease. Determination or causality refers to the genesis of processes in constant development and transformation which appear in specific historical conditions of time and space.<sup>9</sup> This concept is radically different from the causality of classical epidemiology which derives from positivist/neopositivist epistemology and philosophy. Within this “reductionist causality model” reality is limited to empirically observable/measurable phenomena associated with geno- and phenotypes observable at the individual or family level. This model denies general levels of determination which are supersede traditional statistical analysis.<sup>9</sup>

The WHO Commission on Social Determinants of Health (CSDH) conceptualized the social determinants of health as simple “social variables” which could be added to a long list of factors (sex, age, occupation, ethnicity, social group, etc.) which determined health/disease. The Commission reduced structural social processes to a series of em-

pirical measurements that might (or might not) play a role as health determinants depending upon the particular statistical test used to evaluate the data. By contrast, critical epidemiology conceptualizes structural social processes as being constantly in operation; health/disease are always the result of such processes and never a consequence of “social variables.”<sup>9</sup> According to the WHO’s CSDH:

*The poor health of the poor, the social gradient in health within countries, and the marked health inequities between countries are caused by the unequal distribution of power, income, goods, and services, globally and nationally, the consequent unfairness in the immediate, visible circumstances of peoples lives – their access to health care, schools, and education, their conditions of work and leisure, their homes, communities, towns, or cities – and their chances of leading a flourishing life. ... Together, the structural determinants and conditions of daily life constitute the social determinants of health ...*<sup>19</sup>

We undertook this study to describe certain socio-economic aspects of living conditions for mothers and families in Turbo (Antioquia, Urabá), Colombia. We compared pregnant women with gestational malaria to pregnant women who did not have gestational malaria.

## **Materials and methods**

### *Study site*

The region of Urabá is located in the department of Antioquia, Colombia. There are three competing economic sectors in Urabá: the banana economy in Turbo and Apartadó (a capitalist sector ruled by multinational agrobusiness), the plantain economy in Neococli (dominated by small farmers), and livestock production in Arboletes (a sector composed of large landowners and day laborers).

Urabá has an annual parasite index (API) over 10 per 1000 population.<sup>20</sup> The prevalence of gestational malaria is 10%, according to light microscopy (thick and thin blood smear).<sup>2</sup> While violence, war and the systematic violation of human rights have been constant presence in Urabá, they have reached unimaginable extremes since 1980.<sup>21,22</sup>

### *Methodology*

This is a cross-sectional, descriptive study in which we surveyed the living conditions of pregnant women and families in Urabá.

### *Recruitment*

Participating women were recruited from two research projects on gestational malaria; one has been published previously<sup>2</sup> and the other is ongoing. Recruitment sites included malaria diagnosis and treatment posts, prenatal clinics, and obstetrical services of local hospitals; all facilities were within the public/state system. The pregnant women selected for the study were personally approached by the researchers and invited to participate. All accepted.

### *Sample Size*

A random sampling strategy without replacement was used<sup>23</sup> based on the female residents of Turbo (population = 1247; 95% confidence level 95% ( $Z = 1.96$ ); probability of the event = 0.5; sampling error = 0.10). The calculated sample size was  $n=89$ , which we rounded up to 90. The final sample included 45 women who had had gestational malaria and 45 who had not.

### *Definitions*

A history of gestational malaria meant that at some time during pregnancy the woman had suffered acute fever during which asexual forms of *Plasmodium vivax* and/or *P. falciparum* were observed microscopically.

### *Inclusion and Exclusion Criteria*

Inclusion criteria: 1) participation in previous study on gestational diabetes<sup>2</sup> and 2) voluntary participation and signature of informed consent. Exclusion criteria: 1) refusal to continue in the study or 2) a demand to be compensated for involvement in the study.

### *Survey Instruments*

Seven instruments were used:

#### *Maternal surveys:*

1. Maternal work (paid)
2. Maternal work (unpaid)
3. Social characteristics and maternal lifestyles
4. Mother's place of work and exposure to malaria
5. Socio-economic, environmental health and housing conditions
6. Nutrition

#### *Family breadwinner's survey:*

7. Paid work

### *Ethical aspects*

Mothers and their families were invited to take part in the study. They were told the objectives,

procedures, risks, and benefits of the study. If they accepted, they signed an informed consent. The project was approved by the University Research Headquarters' Committee on Human Research Bioethics (University of Antioquia) (certificate CBEIH-SIU 07-032-108 dated 16 August 2007)

### **Results**

#### *Description of the sample.*

Ninety women were surveyed. A complete economic assessment (all seven forms) was obtained for 84. There was no statistically significant difference between women who had had gestational and those who had not for the variables studied, so results are presented for the group as a whole. This means that pregnant women with and without malaria share the same living conditions.

#### *Basic social information on mothers and families*

The vast majority of families lived as nuclear families. (Table 1) Family size averaged 5.4 members. The women are mainly young; 65% are less than 25 years old. Thirty one percent were primigravidas; there was an average of 2.0 previous pregnancies. Years of residence in Urabá were  $18\pm 9$  (median: 18.0). Fifty-four percent lived in urban areas. Sixty-four percent described their ethnicity as chilapo, meaning an immigrant peasant from the valleys of the Sinú and San Jorge rivers in the province of Córdoba.

Mothers' generally had a low levels of formal education. Only 14% claimed knowledge of a particular trade. All worked as housewives ( $42\pm 24$  hours/week, median 33). Only 17% had received any occupational training; eleven trades were mentioned, all of low technical/academic skill.

Among the spouses/steady partners, 81% could read and write; 65% of them had gone only to primary school (of these only 30% completed it) and 35% had some secondary education (with 9% graduating).

Consumption of animal protein was low and only eggs were consumed daily. (Table 1)

#### *Mothers' paid work*

Twenty one percent of the mothers said they did paid work; in all cases their earnings were marginal within the family economic structure. (Table 1) Forty-three percent of these women had stable jobs. Half of the mothers involved in income-generating economic activities worked at home on a freelance basis and owned everything they used for work. The other half worked as dependent workers outside of the home; they did not control or own the items used in their work. These mothers worked

Characteristic	Value
Age (years)	23,0±5,0
Body weight (kg)	58,5
Previous pregnancies	2
Primigravidas	31%
Years resident in Urabá	18±9
Rural residence	46%
Ethnic group: 'chilapo'	64%
Can read and write	86%
Attained primary education	61%
Knowledge of a particular occupation	14%
Received training in any activity	17%
Do housework	100%
Regularly exercise	39%
Use of free time: watch television 45%, play with their children 38%, sleep 26%, chat 17%, read alone or with their children 12%	12-45%
Consume alcohol on weekdays	2%
Take frequent medication	17%
Foods consumed at least once a week: milk and eggs 97%; offal or liver 49%; blood pudding 17%; vegetables/fruit 92%	17-97%
Food consumed at least once a day: Eggs 100%; meat (any) 12.5%; vegetables 30%; fruit 7%	7-100%
Do paid work "Sell cellphone minutes" 25%; other activities 75% (childcare, grocery sales assistant, hairdresser, laundry, domestic worker, store employee)	21%
Stable paid work	43%
* There were no statistically significant differences (p>0.05) between mothers with and without previous gestational malaria.	

during the daytime between 2 to 7 days a week; hours worked varied between seven and fourteen. Of paid working mothers, 63% were direct operators, and 37% were administrators or managers.

The most common paternal occupation (52%) was reported as "miscellaneous" (unskilled or low-

Characteristic	Value
Inhabited by a single family	69%
Inhabited by two families	21%
Type of housing	House 62% Room 14%
Family home	Owned 63% Borrowed 20%
Kitchen separated from other areas of the home	88%
Room to gather together	81%
Bedrooms (average)	2 (1-5)
Persons living in the house	6±2
Persons sleeping in the house	6±2
Roof materials	zinc/sheet metal 73% palm, straw, other 12% mud tiles 7%; other or combinations of the above 15%
Housing with external walls	79%
Wall materials	boards 64%; adobe/blocks 25% both 11%
Floor materials	earth/sand 52% cement/tiles/ceramics: 43%; wood 2%; earth/sand and wood 2%
Fans in bedrooms	in some 62% in all 44%
Mosquito nets	95%
Mosquito nets per home	2.5 %
Persons per mosquito net	2.5 %
Family carries out anti-mosquito activity:	62%
Anti-mosquito activity by families	apply insecticide 25%, use mosquito net 25%, burn cardboard to produce smoke 22%, burn branches to produce smoke 16%, use insecticide and some smoke 6%, fan 6%
* There were no statistically significant differences (p>0.05) between mothers with and without previous gestational malaria.	

skilled jobs). Other occupations included farming (17%) and day laborer (14%, casual work for only a few days a week). Five other occupations comprised the remaining 17%. In 66% of families, the

Characteristic	Value
Domestic water	Own 39% (rural areas); Bought 61% (urban areas)
Mean monthly cost of water (range)	\$15,000 (\$10K—\$35K) [USD 7.80 (5.20 to 18.20)]
Drinking and cooking water obtained from rainfall as only or combined source	76%
Connection to a sewage system	41%
Mean monthly cost of connection to sewage system (range)	\$7,000 (\$5K to \$8K); [USD 3.5 (2.5 to 4)]
Toilet facilities within the home	66%
Type of in-house toilet facilities	toilet bowl with running water or toilet flush 56%; hole or latrine 10%
Cooking fuel	Own 22% Bought 78%
Average Monthly cost of cooking fuel (range)	\$39,000 (\$31K to \$80K) [USD 20.3 (16.1 to 41.6)]
Interior lighting	public utility electricity: 93% non-electric (oil lamp, candles): 7%
Waste collected by public or private company	57%
Uncollected waste	dumped in a yard/plot of land/ditch 12% burnt 12% dumped on the ground or burnt 10% burnt or buried 5% dumped in a waterway/lake 2% dumped in the water or burnt 2% Total: 26% dump waste in the open (on the ground or in water)
Home environment	with vegetation 71%; with stagnant water 45%; with flowing water 17%; both forms 11%
There was no statistically significant difference ( $p>0.05$ ) between mothers with and without previous gestational malaria.	

father had a stable job. Working fathers were always subordinate employees; they never owned the means of production (machinery, equipment, tools, or raw materials).

Characteristic	Value
Working mother's monthly income	\$266,000 [USD 138]
Working father's monthly income	\$324,000 [USD 190]
Families with other members who work and contribute	33%
Contribution by other family members who work	\$166,000/month [USD 87]
Monthly income per family:	
Families with only the father contributing	\$308,000 [USD 160]
Families with both parents contributing:	\$458,000 [USD 240]
Families with both parents plus one other member contributing:	\$674,000 [USD 351]
Families with source of food for consumption	91%
Families receiving regular donations	food 92% food and money 2%; food and other 2%; (clothes, fuel, etc.)
Monthly expenses per family	a) food \$342,000 [USD 178] b) housing rent \$60,000 [USD 31] c) water \$15,000/month [USD 8] d) connection to sewage system \$7,000 [USD 3.6] e) cooking fuel \$39,000 [USD 20]
<sup>a</sup> There was no statistically significant difference ( $p>0.05$ ) between mothers with and without previous gestational malaria.	

#### *Housing and Access to Basic Services*

The characteristics of the families' homes are presented in Table 2. The proportion of homes occupied by one family was 69%, two families 21%, and 3-5 families 10%. Average monthly rent was 60,000 Colombian dollars (about USD 30). Sixty-two percent of families had taken no measures to protect against mosquitoes.

Characteristics of basic family services are listed in Table 3. Thirty-nine percent of rural homes had their own water supply. In 61% of urban homes, water was purchased. For drinking and cooking, three out of four families used rainwater as either their only source of water or a supplement to other sources.

### Family economy

The economic characteristics of the families are summarized in Table 4.

In 79% of the families the sole source of income came from the father. For this group monthly income averaged 308,000 Colombian dollars (USD 160); this was 62% of the then-current (2009) legal minimum monthly wage: \$490,000 (USD 255). For 21% of the families paternal earnings were supplemented by income from the mother. Monthly income in this group averaged \$458,000 (USD 240); this is 93% of the minimum monthly wage. Finally, 33% of families received income from both parents as well as another family member. Monthly income in this groups was \$674,000 Colombian dollars (USD 351).

Average monthly expenditures were as follows: food \$342,000 (USD 178/month); rent \$60,000 (USD 31, 17% of the families paid this); water \$15,000 (USD 8, 61% of the urban families purchased water); connection to sewage system \$7,000 (USD 3.6, an expense for 41% of families); cooking fuel \$39,000 (USD 20; 78% of families, nearly all urban).

Monthly expenditure per family for food was approximately \$342,000 (USD 178). Nearly half of the families (n= 41) of families had to pay additional charges for rent, water, sewerage and fuel; these averaged \$27,000 (US\$ 14) and brought their monthly total to \$369,000/month (USD 192).

### Discussion

This study allows a better overall understanding of gestational malaria in Urabá, Bajo Cauca, Alto Sinú, and Alto San Jorge (Colombia). It may also provide insights into areas that are similar epidemiologically and socially; these might include many areas in Latin America, Africa, and southern Asia. Research on gestational malaria has involved the measurement of gestational and placental malaria prevalence;<sup>2</sup> rates of malnutrition and psychomotor retardation in children of women affected/unaffected by gestational malaria (Zuliani et al: in press); and the epidemiological and histopathological description of placental malaria (Carmona-Fonseca et al: in press).

Advances have been made in the genetic study of those *Plasmodium* species involved in gestational malaria and in the study of cytokines and apoptosis markers in placental infection. Rapid diagnostic tests for malaria are in clinical trials<sup>24</sup> and studies have been conducted comparing thin smears and placental histopathology to nested polymerase chain reaction (nPCR) as a way of detecting parasites in maternal, placental and umbilical blood.<sup>25</sup>

Our cohort of mothers/families were characterized by very low incomes. Family members were primarily involved in informal employment which was characterized by low levels of skill, dependency, instability, and low remuneration. Only a very small percentage of mothers (20%) had paid work. Parents generally lacked formal education, and only a few women had any training for formal occupations. Living conditions—both in and outside of the home—were precarious and basic public services, such as water and the removal of excreta and waste were deficient. Families consumed very low amounts of meat, vegetables, and fruits. Free time was not well used. A surprisingly high percentage of mothers said they felt sick.

These and other indicators point to the severely deteriorated state of living conditions. This population has a high level of unmet basic needs, specifically those needs associated with “basic consumption” (which include food, housing, clothing, rest/leisure, natural goods (water, air, microclimates). These basic needs comprise those goods and services which enable individual physical recuperation. Those needs related to “expanded consumption” (such as education, health, technical training, artistic activities, consumption of accessory and/or luxury items) were even further from being satisfied.<sup>15,16</sup>

We found no significant differences in study variables between pregnant women with and without gestational malaria. Our data, however, was limited to social determinants at the level of single families. Since our subjects nearly all lived in abject poverty it may have been difficult to find differences at this level. Our data did not address other levels (e.g. intermediate or deep) of social determination.<sup>15,16,26,27</sup> It did not address either higher level determinants (such as the ways in which social groups and classes are reproduced) nor the modes of reproduction of social groups and classes) nor the deeper levels of how these processes were expressed in the daily life of individuals and their families. In classical epidemiology the satisfaction of basic needs—be it of individuals and families or of social groups and classes—depends on how independently-acting “variables” or “risk factors” produce the “effect” or “event” of interest (living conditions, state of being either healthy or diseased, etc.). These outcomes, however, depend upon complex social and historical processes which create epidemiological profiles which are specific to a social group or class; they cannot be simplistically reduced to a set of variables/factors which might or might not be statistically related. Epidemiological

profiles generate either protective or destructive processes.

Living conditions play a determining role in the health/disease of individuals and, more specifically, of social groups/classes. They must be studied as historical processes (which are social and not simply natural) which can be organized into three interdependent and hierarchically organized dimensions:

1. the *general domain* explains the structure and operation of society in general. This includes mode of production, ideological/political apparatus, social organization, and culture;
2. the *particular domain*<sup>\*</sup>, which explains how social groups or classes are reproduced, interact, and evolve, and
3. the *individual domain*, which explains the processes and phenomena of the daily life of individuals and families, and deals with individual and family lifestyles.<sup>15,16</sup>

The empirical data gathered during this study documents the highly precarious living conditions affecting almost all the families studied. It is highly likely that the homogeneity of their living conditions reflects our recruitment methods; all subjects were users of the public/state health service. None of the families in this group were members of the health service supported by the banana and plantain exporters. The families were covered by the General System of Social Security in Health (SGSSS) through one of three mechanisms: 1) contributions made by employees and employers at the workplace (62%), 2) direct State subsidy (17%); and 3) special programs involving a combination of employment contributions and State subsidy (21%; these programs cover teachers, police, and other groups). This is consistent with the fact that over 90% of the families studied are classified in levels 1 to 3 of the *sisben*, a name given to the Colombian identification system for beneficiaries of social services (unpublished data).

Further studies will be needed to clarify the relationship between the social determination of gestational malaria in this population and the general, particular, and individual processes mentioned above.

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<sup>\*</sup>The particular domain involves the study of production methods and practices in the context of social space; gender segregation in the workforce; the characterization of community and work spaces; the description, distribution, and quality of both basic and expanded consumption; possibilities for strengthening the political and social roles of subjects; etc.

Available information, particularly from African researchers, demonstrates that malaria and gestational malaria are public health issues<sup>28-30</sup> whose impact falls primarily on populations living in the worst conditions and predominantly on women. These conclusions are amply supported by the international evidence. In addition to those papers mentioned in the introduction, we could cite the following conclusions, many of which are consistent with the findings of our study:

- Multiple studies have identified exclusion and structural change in societies as one of the processes determining the limited right to health of millions of inhabitants; the poverty map coincides with the malaria map.<sup>31</sup>
- Municipalities in Cuba with the worst living conditions have the highest rates of maternal/child mortality and a greater frequency of low birth weight.<sup>32</sup>
- As one descends the social hierarchy, the mortality rate increases. Even when the risks of the physical environment are not that different, socio-economic differences are still important.<sup>33</sup>
- Gender-based power relations strongly influence treatment decisions with respect to malaria: who is treated, when, and with what. Often the male head of the household decides.<sup>34</sup>
- The financial burden of malaria treatment directly affects families, who must work harder to cover these expenses.<sup>35</sup> In Peru, a case of malaria costs a family on average 300 new soles (USD \$110); families average five cases of malaria each year. For rural families living in the jungle—70% of whom are poor—these costs can be equivalent to one third of their annual income.<sup>36</sup>
- The economic impact of gestational malaria has not been well measured.<sup>37</sup>

The results of this study are consistent with those of research on living conditions in other Colombian provinces, notably Antioquia and Urabá. In 2005, 49% of the Colombian population were classified as poor: 68% of the rural population and 32% of the urban population. This number excludes the “destitute” which represented 15% of the population in 2006.<sup>38</sup> In 2004, 44% of the population of Antioquia had unmet basic needs; another 15% lived in squalor. In Urabá 59% live in poverty; in Turbo 69%.<sup>39</sup> Seventy percent of Colombian peasants live “in abject poverty” while “current levels of rural poverty are similar to those of a decade ago, in other words during the last few years

there has been no social progress in the countryside.<sup>40</sup> In Turbo, 63% of children aged 3-11.5 years have chronic malnutrition<sup>42</sup> while 80% of children aged 4 -10 years old suffer from pathogenic intestinal parasites.<sup>42</sup> In 2006, pregnant women in Urabá were often affected by malnutrition, and 60% of homes suffered slight to moderate food/nutritional insecurity.<sup>43</sup>

Inadequate living conditions similar to those we have described in Colombia are common in areas across the globe where malaria is endemic.<sup>6,9,10,31,44,45</sup> Malaria is generally found in countries which are economically and politically dependent on the dominant capitalist economies, such as the Congo,<sup>46</sup> Brazil,<sup>47</sup> Peru,<sup>48-50</sup> Ecuador,<sup>49</sup> Honduras,<sup>51</sup> and Colombia.<sup>45</sup>

The above considerations do not take into account all the elements essential to the quality of life. What is called “development” should be understood as a complex process that cannot be reduced to the economic vision which prevails in the western capitalist world.<sup>52-54</sup> Other development models privilege the well-being of humans over that of corporations.<sup>44</sup> Finally, we would underscore that the relationship between health, living conditions, and development should be obvious.<sup>55</sup>

### Conclusions

In Urabá (Colombia), living conditions for pregnant women and their families are below the standards considered sufficient to meet both personal and family needs. Poverty and destitution are the predominant economic reality. The home environment and family practices strongly favor the presence of malaria.

Four out of every five women depend financially on their spouse/partner or the family. Women who work generally do so in marginal activities which generate little income and job satisfaction.

This study contributes to the understanding of the social determination of malaria and gestational malaria in Colombia and around the world. This line of work merits further exploration, given its high social relevance, the harsh living conditions of these population groups, and the extreme paucity of research on the subject.

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### Authorship

Each of the authors fulfilled with the criteria for authorship applied by the Journal and each contributed to the writing, correction, discussion, and final approval of the document.

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