

CHIKUNGUNYA, A WATER-BORNE DISEASE: HOW HAVE THE INHABITANTS OF THE ISLAND OF REUNION HANDLED THE CRISIS?

Maryse Gaimard¹, Dominique Soulancé², Daniel Bley³, Nicole Vernazza-Licht⁴

¹ University of Bordeaux Segalen, Centre Emile Durkheim and CEPED UMR 196 (Paris Descartes-INED-IRD), 33076 Bordeaux, France, e-mail : maryse.gaimard@u-bordeaux2.fr

² University of Lille 3 and ADES UMR CNRS 5185, 33000 Bordeaux, France, E-mail : dsoulance@free.fr

³ UMR 7300 ESPACE/DESMID, CNRS, Aix-Marseille, France, E-mail : daniel.bley@univmed.fr

⁴ UMR 7300 ESPACE/DESMID, CNRS, University of Nice Sophia-Antipolis, E-mail : nvernazza@aol.fr

Abstract

The Reunion Island faced a great epidemic of chikungunya in 2005-2006. Chikungunya is a vector-borne disease transmitted by a mosquito. It is in the town of St Pierre, in the south of the island, that the first cases of chikungunya appeared in 2005. We chose to work on one area of the Ravine des Cabris, in the town of Saint-Pierre in the south of the Reunion Island, where individual housing outweighs the block of flats, where houses are surrounded by gardens – closed in for most of them, well watered- and where the foliage is important: we are in a green urban area which is a place of high prevalence. It concentrates the conditions that favour the contact man / vector and therefore the spreading of the epidemic. The study of chikungunya disease and the gardens of the Ravine of Cabris in Reunion is part of a research project ANR SEST (2006-2009) "Anthropo-MTV". In this article we shall make use of the results that ensue from two surveys conducted in 2007 and 2009. One of the fundamentals to fight the epidemic was the implementation of measures to cleanse the environment, especially regarding the watercontrol. Those measures, that concerned both collective and individual spaces, particularly gardens, were accepted in different ways depending on the people. People are proud of their gardens; they are part of their identity. Never had they thought that, one day, their garden would be the cause of their illness. The aim of this paper is to show how the Reunionese people have handled their environment during the epidemic. It was observed, 18 months after the epidemic, that the vector control remained the most effective measure to prevent chikungunya, but this has not been assimilated by everyone. It can therefore become problematic in the case of a re-emergence of the disease.

Keywords: Chikungunya, mosquito, water-borne disease, Reunion Island, health, urban area, individual housing, environment.

1 INTRODUCTION

The island of Reunion went through sanitary conditions that had never been experienced so far, due to the Chikungunya epidemic that swept through the Island in the years 2005-2006. It was the first time that this alpha virus was isolated in Reunion. The epidemic spread through the island rapidly, thereby surprising greatly by its gravity and its intensity, the local and national sanitary authorities of this overseas territory where the tropical diseases seemed to be under control. It started in the Comoros in December 2004 and reached Reunion towards the end of March 2005 when the very first infection was spotted. With just a few isolated cases in the beginning, the epidemic soon gained ground and finally exploded during the austral summer, in December 2005 and January 2006. Officially, the epidemic is over, since spring 2007. On the whole, during the epidemic, 38% of the population was infected with the Chikungunya virus, that is to say 300 000 persons on a total population of 800 000 (Gérardin and al... 2008). There is still a risk of a revival of the epidemic and as the Health Development Service puts it: "in spite of the importance of the epidemic recorded in 2005-2006, the population is still likely to be infected and a similar phenomenon may take place again".

The Chikungunya is a viral disease, transmitted by a mosquito of the type *Aedes*, *Aedes albopictus*, which remains active the whole day (Gäuzere and Aubry, 2006). The symptoms of the severe form of the disease transmitted by the Chikungunya virus are: high fever, outbreak of rashes and stun pain in the joints (disabling arthralgia). It is a disease that prevails specifically in tropical regions; it is quite an uncommon and rare illness and hence there is very little research on it (Pialoux and al., 2006). It was in 1952-1953 that the virus was identified for the first time in Tanzania. Since then, a number of Chikungunya epidemics have been reported in Africa and in Asia. The infections provoke high fever, rashes and particularly stun pain in the joints that can last just a week or many months (Guillery, 2005; BEH, 2008). Along with the physical pain, comes the anxiety of the after-effects, and also sometimes of the direct or indirect death caused by the

virus (Taglioni 2009). Not a single antiviral treatment is available for the moment. Those treatments meant to relieve the pain and available at the market, include antipyretic and anti-inflammatory medicines and also some movements and mild exercises recommended for the improvement of the stiffness in the joints. The only possible prophylaxis consists in reducing to the minimum the risk of being bitten by contaminated mosquitos through the use of insectifuges.

In the absence of a specific treatment or vaccine, the only means of controlling the disease was to take urgent steps to fight against the vector in view of destroying the mosquitos and above all of getting rid of the larval beds (Fontenille and al., 2009; Fenetrier and al., 2008). The main biotope for the *Aedes albopictus* is the vicinity of housing estates; since it is anthropophagous it adapts itself very well to the shelters that man provides it with (old tyres, empty tin cans and bottles, discarded containers, swimming pool covers, frameworks of domestic appliances, vehicles or even graveyard vases). The mosquito reproduces itself in small puddles where water stagnates in shady areas wherein the female mosquito is able to lay 3 to 4 collections of about a hundred eggs during its short life (a maximum of 3 to 4 weeks). Each time it lays eggs, the female mosquito has to feed on “a meal of blood” drawn out from a hot-blooded animal (Fontenille, 2006). The gardens provide the utmost favorable conditions for its growth and reproduction. The *Aedes albopictus*'s activity is strictly diurnal: it bites its victims essentially at daybreak and at nightfall.

Information campaigns (public notices, newspapers, radios...) and mosquito clearings have been installed by the authorities (the Regional Directorate of the Department of Health and Social Services, the Town Councils, the State/Armies). They were subject to controversy in the opinion of the population that did not know how to link environment and health regarding the Chikungunya disease and was not ready to agree promptly with actions that perturbed their ways of managing their proximate environment on a day-to-day basis (Lombard, 2006; Taglioni, 2009; Bley, Setbon, 2009). These safety measures emphasized on the risk constituted by the gardens and the population was quickly solicited to participate through their influence on their environment: getting rid of the potential sources of breeding grounds (tyres, articles stored outside, saucers under the flowerpots, green waste matters), cleaning the drainpipes in the houses, covering the rainwater tanks, emptying the ponds or replacing with sand the water in the flower pots in the graveyard.

The epidemic in Reunion, arising in the midst of a population having an efficacious system of surveillance and elaborate infrastructures, was amazing by its massive and prolonged nature, and it brought to light a number of unknown factors, particularly regarding the management of such a crisis. It gave rise to a number of interrogations among the population about the ecology of the mosquito, the preventive measures and their efficiency, the acquired immunity, persons at risk, and as weeks went by, wavering feelings about the political actions that had been undertaken to handle the situation.

2 METHODOLOGICAL FRAMEWORK OF THE STUDY

The target of the study carried out in La Ravine des Cabris (a locality in the town of Saint Pierre) within the framework of the project ANR SEST “Anthropo-MTV” (2006-2009) was to deepen the knowledge of emergent and/or re-emergent diseases (Chikungunya, Dengue...) relying on inter-disciplinary approaches combining sociology, anthropology, geography, demography, psychology and medicine. This research permitted to one extent to specify the socio-demographic characteristics and determinants and to another extent to apprehend the representations of the disease and the perception of risks by the Reunionese population as well as the functioning of the administration of the domestic vicinity, backed up by both qualitative and quantitative studies. It was also a question of clarifying the nature of the links between mosquito-insalubrity-population and to analyze the nature of the constraints that weigh upon the implementation of efficient measures of prevention that had been recommended (economic constraints, but also the tensions between everyday life and the adoption of constrained measures).

The survey was conducted in November 2007, that is to say eighteen months after the epidemic, and was focused in an exhaustive manner on all the people living in individual houses, the milieu most exposed to the risk of contamination. This locality corresponded to a privileged zone of study of the Chikungunya due to a concentration of conditions favoring the contact man/vector and consequently the spreading of the epidemic: a low altitude (between 300 and 400 meters), an urbanized zone but still densely vegetated, a trace of Creole in the population, a high density of *Aedes albopictus* mosquito. Moreover the Ravine des Cabris was one of the first areas in the Island to be affected by the epidemic.

The survey unit concerned the housework which comprises mainly the management of the environment, especially of the garden, and of the group wherein one has to organize oneself to either face the disease or prevent it. The approach to this problem had a double action; it combined the quantitative and the

qualitative approaches. The survey was composed of two units: a socio-demographic questionnaire with a section on the habitat and a questionnaire on the environment and health.

The socio-demographic survey permitted to make a population census of the households living in the area of survey and to understand their major characteristics (age, sex, place of birth, married status, level of education, employment, place of work, etc.). The section dealing with the habitat collected characteristics of the housing (type of construction, conveniences in the dwellings, the statutes of occupancy, etc.) and information concerning the daily practice of the household in the field of domestic environmental managements: up-keeping of the garden, the network of water circuit and domestic garbage, methods of storage. The sanitary risks threatening the households have thus been assessed. Two other observations of gardens, made in 2007 and 2009, complete the survey. The survey on the environment and health took interest in the description of the household and its health conditions, namely: knowledge of Chikungunya and other vector diseases (knowledge of the disease, of its symptoms and the way it is transmitted); in the representations connected with the etiology of Chikungunya and other vector diseases and the population's perception of risks; in the health care and the methods of prevention adopted by the invalids in the cultural context of medical plurality. This questionnaire was sent to only one adult in each surveyed household. On the whole, 415 households composed of 1267 persons have been surveyed; they represent two-thirds of the dwellings and of the population living in the center of Ravine de Cabris, where the total number of inhabitants is 2101, and they live in 655 main homes. The households that were surveyed, are generally small, comprising 3, 08 persons (15% of them are lonely persons). Almost three-fourths of them are natives of Ravine des Cabris or its neighbourhood; only 14% are born in a European country. So the surveyed population is relatively stable geographically, and they are locals. This population is slightly older than that of the Island and of the district of Saint-Pierre where 19% of the inhabitants are 60 years or above (against 11%). A great majority (58%) of the surveyed population, declared to be out of work, 30% of whom are pensioners. Those who said to have a job belonged mostly to the middle class: employees (16%), intermediate professions (10%) or laborers (8%) mixed with a few tradesmen and craftsmen (4%). And the corollary of the professional status and the age is that almost a quarter (22%) of the persons of 20 years or above who had been questioned had attended the primary school and 17% had gone to the university. Among all the persons who were questioned (all sex and age put together), almost everyone (except 5% of them) were present during the Chikungunya epidemic. The demographic profile of the population influences the speed of propagation of the disease and thus its prevalence.

3 RESULTS

The results focus on the characteristics of the persons suffering from Chikungunya, on their behavior with regard to the disease but also on the knowledge of the population concerning their natural environment, namely the localization of larval beds in the vicinity of housing complexes, the differentiation of the different types of mosquitos, the transmission of the illnesses through a vector (flies, mosquitos, etc.) as well as the management of the neighboring environment and the measures of prevention that they have incorporated.

3.1 *Prévalence of chikungunya*

Among the population that was questioned, 57% of them declared having caught the Chikungunya during the epidemic (between 2005 and 2007). This percentage seems to be higher than the one supplied by the National Institute of Public Health, according to which 38% of the Reunionesse population had contracted the Chikungunya. The specificity of the habitat that was surveyed explains this phenomenon: individual residences having gardens favor the spreading of the epidemic. The prevalence of Chikungunya expressed itself differently depending on the socio-demographic characteristics of individuals. The native population, that is to say those born in Reunion, has been more affected than the foreigners (61% versus 45% for persons born in Europe).

Women have evidently been more contaminated than men (58% versus 56% respectively) following the example of what had been observed at the State level. A few explanations have been expressed: "a greater exposure in the gardens, a larger part of their body being uncovered, a higher attraction exerted on the mosquitos...? This phenomenon had also been noticed during the dengue epidemic in 2004" (Gaüzère and Aubry, 2006, p.50). The most affected age brackets were the adults of 40 years or more, and particularly those who were above 60 years, 80% of whom had contracted the disease. One of the main particularities of the epidemic in Reunion was that too many old people had contracted the disease. The aged withstand with

difficulty all types of fever, for the organism's water reserves decrease as you grow old and often these people are subject to other ailments connected with old age and to a certain degree with under nutrition. Old people who live isolated, run also the risk of not getting assistance in due time (Gaüzère and Aubry, 2006).

The prevalence of Chikungunya varies also according to the people's standard of education and their professional status. The adults who had no schooling or who had a low standard of education (primary school) were infected more often (75%) than those having a secondary school qualification (60%) or a university diploma (42%). It is chiefly the workers, the pensioners and the housewives who have been infected (74%) more than the average population; whereas the executives (37%) and the intermediary professionals (40%) are looked on as the privileged. It should be underlined that there is a close reciprocity between the academic level and the place of birth as well as with the job. All these factors are interdependent. There is a link between the risks of infection and certain determining factors related to culture, economy, environment; health and education too work upon the risks of infection. The demographic profile of the population influences the acceleration of the propagation of the disease. The prevalence of the epidemic and its distinctive aspects depend also upon the idea and the knowledge of people about the Chikungunya.

3.2 Representation and knowledge of the disease

One of the units of the survey focused on the knowledge and the description of the disease by the inhabitants of Ravine des Cabris. Actually in the case of diseases transmitted through a vector, it is essential to have an idea of what the people know about the particulars of the disease and especially its means of transmission, so that the measures of prevention targeting on the environment (administration of water, up-keeping of housings and gardens ...) are really efficacious.

Eighteen months after the epidemic had ended, it has been noticed that 82% of those who were interviewed mention that the mosquito is the vector of the disease. This percentage is quite surprising for, in spite of all the campaigns and the overmedications against the Chikungunya, almost 10% of them are unable to answer the question and 8% give inaccurate answers. As for the question whether all the mosquitos transmit the Chikungunya virus, the answer is identical: 85% of the persons know the answer (and therefore seem to have incorporated all the messages relative to *Aedes albopictus*). On the other hand, fewer persons were able to say at what time of the day the mosquito is the most dangerous: 65% of the persons who had been interviewed gave a wrong answer. This lack of knowledge has a repercussion on the preventive actions: how can people protect themselves efficaciously if they are unaware of the moments when they are the most exposed? The knowledge about the transmission of Chikungunya brings to light the distinctions that are more or less striking through the various demographic and socio-economic parameters. Though there are no differences according to the sex or the marital situation, the knowledge about the transmission of Chikungunya decreases with age. It has been noticed that those who are less than 40 years, experience the illness in 90% of the cases whereas in the case of those who are above 60 years, it is only 70%. Among those who are born outside the Island (or in metropolitan France or in a European country) 100% of them experience the transmission of the epidemic while the Islanders who mention the mosquito, are between 74% and 82% of the cases. Disparities have also been observed in relation to the standard of education and the socio-professional groups. It appears clearly that the method of transmission of Chikungunya is all the more well-known by the people whose standard of education is high. All the persons who have done higher studies know that it is the mosquito that transmits the illness while only 64% of the persons who have gone only up to the primary school are aware of this fact. On a similar way, it is those who practice a liberal profession as an executive or belong to a comparable category, who have a knowledge of the method of transmission (100%) compared to agriculturalists and laborers who are only 74% to know that the mosquito is the vector of Chikungunya. Otherwise, concerning the fact of being active or not, it is the pensioners (71%) who know the least about the method of transmission; this fact has to be surely put together with the results found about the effect of age. Both the disease and its method of transmission are not well known by those who are highly affected by the Chikungunya, but also by those who are not well-disposed to the ridding of mosquitos (67% against 84%) and those who clean less frequently their garden (83% against 93%). In fact, in the case of a vector disease, the management of the nearby environment is essential.

3.3 The management of the nearby environment

In the case of Chikungunya, the environmental factor plays a major role in the risk of an infection, namely in private housings, and this is the focus of our study. On the whole, the domestic environment of the inhabitants presents good healthy conditions. The households that have been surveyed live on plots of land

whose average size is around 600 m² and three-fourths of them own their house, 90% of which are a permanent structure with an open verandah. All of them are provided with modern sanitary fittings but only one-fourth of them are connected to the sewage system. Though the majority of households (77%) are equipped with fans or air conditioners, very few (7%) own mosquito screens on the windows even 18 months after the epidemic, though it is quite clear that to keep oneself free from Chikungunya it is necessary to use means of diurnal protections. All the houses have a garden in the front; most of them have one also at the back, with at least one water point (tap, tank for collecting rainwater and a few ornamental ponds).

The garden is luxuriant and the density as well as the diversity of the plants and flowers give it a look of a very colorful and inextricable mess, but yet orderly. Often the fruit trees offer it a leafy shade. It corresponds to a variety of uses: it protects, decorates, feeds and heals. Since it is enclosed, it protects; it decorates because it is an area assigned to flowers with thick forms and blending various colors; it nourishes with its fruit trees, its aromatic plants and its spices; it heals with its medicinal plants. The traditional medicine based on medicinal plants is still greatly utilized in Reunion, and the limited value of the official medicine concerning the Chikungunya epidemic, has led the population to turn towards local plants. The inhabitants seem to have well integrated all the preventive measures concerning the garden provided you stick to the fact that on the whole (75%) the gardens are well tended and that too quite regularly, several times a week. The up-keeping of the garden is the duty of the head of the family with the help of his wife and quite rarely with that of the children; it takes place usually in the morning, at the time when the female mosquitos bite. The large prevalence of Chikungunya among the housewives (74%) and the retired persons (74%) can be explained by the fact that they are quite active outside, in the garden.

The gardens are well kept, yet it has been noticed that certain practices favoring the development of the disease still persist. Yes, in every one out of an average of four gardens, the saucers under the flowerpots have been detained although the prevention of Chikungunya goes through the suppression of these saucers in order to avoid the presence of stagnant water in the garden and the proliferation of larvae. In the same way, the rear of the house is not always as well cleaned as the front side and in one quarter of the gardens, we could see stockpiled articles (usually wood, empty bottles, worn out articles, frameworks of domestic appliances, tyres and various building material...) devoid of any protection, neither covers nor closed shelters. They are, in fact, very rarely protected from humidity and have turned out to be so many beds necessary for the reproduction of mosquitos. Whereas the regular location and elimination of those larval beds in the vicinity of the housings, at least once a week, remains one of the most efficacious means of putting a break to the proliferation of mosquitos and protecting oneself from the diseases they transmit. These sanitary measures taken by each one can have an obvious effect, especially since the mosquito having reached adulthood, hardly moves away from its birthplace.

The water management is primordial in the up-keeping of the gardens and the watering remains an important feature denoting an overconsumption of water. In fact there is no need to say that due to the low price of water in Reunion, the households have practices that do not spare water. Water, the source of larval beds, is considered to be an inexhaustible resource and also a common property at the disposal of all the inhabitants; this explains the presence of water in all the gardens. The reduction of the water consumption, as a measure of prevention of vector diseases, does not exclusively go through the price rise considering that the price claim is poorly flexible. The price rise must go together with complementary measures taking into account the size of the garden, and should be added to it the campaigns for informing and reviving the public opinion on the use of the exterior. So, the Water Board of Reunion, by encouraging the people to save water through a good management, makes them cooperate, in some cases, against their will, in the decontamination of the environment.

CONCLUSION

The population that has been surveyed during our enquiry that had been carried out in the locality of Ravine des Cabris (Reunion Island) eighteen months after the Chikungunya epidemic, living exclusively in individual housings, has been affected by the disease more severely than the average Reunionese population. The individual and socio-demographic characteristics of the people who had been surveyed (individual housings, elderly people, great number of pensioners, low level of education) can account for this high prevalence. The structure of the garden (types of clumps, plants, lawns...) and the watering system turn out also to be risk factors in the case of a vector disease such as the Chikungunya (Soulancé, Gaimard and al., 2011). Eighteen months after the epidemic, and in spite of a great coverage of the event through the media, it is a known fact that the people did not have an exact and full knowledge of the disease nor of its mode of transmission and they were not much concerned about its risks. Some persons do not link together disease

and the contact man/vector. Just a third of them evoke natural causes such as mosquitos (20%) or the natural environment (10%) and another third of them state anthropic causes such as lack of hygiene or the bad control of the garbage. The inhabitants of Ravine des Cabris have also proved that they were not personally much concerned by the “Chikungunya” risk. They justify the differential degree of exposure to Chikungunya and the prevalence of the disease through distinctive characteristics of an individual, such as immunity, vulnerability or luck rather than through a preventive behavior. The people who have been surveyed have thus expressed their helplessness and their lack of personal commitment towards the epidemic (Bley and al., 2008). Therefore, they did not get much involved in the management and the prevention of the disease. The means of protection, although they are considered to be efficacious, have been regarded as hardly accessible and difficult to use, namely the cleaning of gardens and the management of the water supply. It is, therefore, not at all surprising that eighteen months after the epidemic that severely affected the Reunion Island, and in spite of the numerous campaigns meant to inform and communicate, a part of the population finds it difficult to establish a connection between environment and health in the case of transmitting vector diseases and has failed to integrate the various preventive measures that have been recommended. The passion of the Reunionese for their garden explains their poor adhesion to the anti-vector fight urging them to eliminate the larval beds by removing the saucers from under the flower pots, by withdrawing the waste matters from the back of their house and by covering the rainwater tanks. In fact it is at the level of the household that the Chikungunya epidemic got settled partly. The type of the garden and its up-keeping, constituted a risk factor in the propagation of the disease. Thus, the population does not seem to be sufficiently involved in the prevention and the management of a vector transmitted disease and does not seem to be in a position to face a re-emergence of the epidemic.

REFERENCES

- B.E.H., 2008. *Qu'avons-nous appris de l'épidémie de chikungunya dans l'Océan Indien en 2005-2006 ?*, n° thématique 38-39-40.
- Bley D., Setbon M., 2009. Perceptions et IEC sur la lutte antivectorielle. In *La lutte antivectorielle en France*, D. Fontenille et al., Marseille, IRD Éditions, coll. Expertise collégiale, pp.319-349.
- Bley D., Ernst-Vintila A., Gaimard M., Sou lance D., Vernazza-Licht N., 2008 - Le chikungunya à la Ravine des Cabris (commune de Saint-Pierre, Ile de La Réunion). Premiers résultats d'une enquête pluridisciplinaire sur les comportements et perceptions, *Société de Pathologie Exotique*, <http://medecinetropicale.free.fr/socpathex.htm>.
- FENETRIER E., VERNAZZA-LICHT N., BLEY D., MALVY D., SISSOKO D., AUBRY P., GAUZERE B-A., 2008. *La gestion de l'épidémie de chikungunya 2005-2006 à La Réunion par le médecin traitant*, Réunion de la Société de Pathologie Exotique, St Denis de la Réunion, 25 novembre 2008, communication.
- Fontenille D., Schaffner F., 2006. Le tour du monde d'un moustique, *Sciences au Sud, le journal de l'IRD*, n°34, mars-avril, p.3.
- Fontenille D., Lagneau C., Collinet, S., Lefait-Robin R., et al., 2009. *La lutte antivectorielle en France*, Marseille, IRD Éditions, coll. Expertise collégiale, 536 p.
- Gauzere B-A, Aubry P., 2006. *Le chik, le choc, le chèque. L'épidémie de chikungunya en questions*. Sainte-Marie, Azalées Editions, 104 p.
- Gerardin P., Perrau J., Fianu A., Favier F. 2008. Déterminants de l'infection à virus chikungunya à La Réunion : résultats de l'enquête Serochik de séroprévalence en population, août-octobre 2006, *Bulletin épidémiologique hebdomadaire*, 38-39-40: 361-363.
- Guillery J-M., 2005. Chikungunya, une crise largement sous estimée. *Magazine de la communication de crise & sensible*, Nave, Editions OIC, Observatoire National des Crises.
- Lombard J., 2006. *L'épidémie moderne et la culture du malheur. Petit traité du chikungunya*. Paris, L'Harmattan, 120 p.
- Pialoux G., Gaüzere B.-A., Strobel M., 2006. Infection à virus Chikungunya : revue générale par temps d'épidémie, *Médecine et maladies infectieuses*, 2442.
- Sou lance D., Gaimard M., Bley D., Vernazza-Licht N., 2011 - Lieux de vie et santé des populations: l'exemple du Chikungunya à La Réunion, *Cahier de géographie du Québec*, numéro thématique Géographie de la santé, vol. 55, n° 156.
- Taglioni F., 2009. Chronique d'une crise sanitaire, économique et sociale. L'île de La Réunion face au Chikungunya. *Infogéo*, <http://anastasia.univ-paris1.fr/infogeo/Fichiers/DescriptifsArticles/Chikungunya.pdf>