U.PORTO
INSTITUTO DE CIÊNCIAS BIOMÉDICAS ABEL SALAZAR
UNIVERSIDADE DO PORTO

U.PORTO
FACULDADE DE CIÊNCIAS
UNIVERSIDADE DO PORTO

U.PORTO
FMUP FACULDADE DE MEDICINA
UNIVERSIDADE DO PORTO

ASSESSMENT OF COMMUNITY PERCEPTIONS REGARDING DENGUE PREVENTION IN MADEIRA ISLAND, PORTUGAL

Teresa Lobo Machado Sousa Nazaré

Tese de doutoramento em Biologia Básica e Aplicada

2014

Teresa Lobo Machado Sousa Nazaré

ASSESSMENT OF COMMUNITY PERCEPTIONS REGARDING DENGUE PREVENTION IN MADEIRA ISLAND, PORTUGAL

Tese de Candidatura ao grau de Doutor em Biologia Básica e Aplicada submetida ao Instituto de Ciências Biomédicas Abel Salazar da Universidade do Porto.

Orientadora - Professora Doutora Rosa Teodósio
Professora Auxiliar, Unidade Clínica Tropical, Instituto de Higiene e Medicina Tropical, Universidade Nova de Lisboa, Portugal

Coorientadora - Professora Doutora Carla Alexandra Sousa
Professora Auxiliar, Unidade de Parasitologia Médica, Instituto de Higiene e Medicina Tropical, Universidade Nova de Lisboa, Portugal

Coorientadora - Professora Doutora Graça Porto
Professora Catedrática Convidada, Instituto de Ciências Biomédicas Abel Salazar, Universidade do Porto, Portugal
Investigadora Principal, IBMC – Instituto de Biologia Celular e Molecular

The research described in this thesis is inserted in the GABBA – Graduate Program in Areas of Basic and Applied Biology (Universidade do Porto) and was performed at the Instituto de Higiene e Medicina Tropical (Universidade Nova de Lisboa). Present work was possible to realize due to collaboration with the Madeira Health Authorities, the Institute of Health Administration and Social Affairs (IASAUDE, IP-RAM) and the financial support from Fundação para a Ciência e Tecnologia, Portugal (Ref. SFRH/BD / 51012 / 2010 and Ref. PTDC/SAUEPI/115853/2009).

O trabalho de investigação descrito nesta tese está inserido no Programa Doutoral em Áreas da Biologia Básica e Aplicada – GABBA (Universidade do Porto), e foi realizado no Instituto de Higiene e Medicina Tropical (Universidade Nova de Lisboa). A realização deste trabalho foi possível graças à colaboração com as Autoridades de Saúde da Madeira, o Instituto de Administração da Saúde e Assuntos Sociais (IASAUDE, IP-RAM) e foi financiado pela Fundação para a Ciência e Tecnologia, Portugal (Ref. SFRH/BD/51012/2010 e Ref. PTDC/SAU-EPI/115853/2009).

PREFACE

This dissertation assembles data obtained as a result of my PhD research within the framework of the project "Dengue in Madeira archipelago"[1].

This thesis is structured in 4 chapters, preceded by a summary both in Portuguese and English.

The first chapter provides an insight on previous knowledge regarding prevention of dengue disease. The objectives of this work are also presented in this section.

The second chapter comprises the questionnaire survey performed before the dengue outbreak that occurred in Madeira Island, in 2012. It includes two different sub-chapters. The first presents the results already published (i). Second sub-chapter covers relevant data also collected before the dengue outbreak, but not included in the mentioned paper (i).

The third chapter presents the results of main work performed after the dengue outbreak. It comprises two different surveys, separated in two different sub-chapters. One presents a questionnaire survey, the other comprises a focus group survey.

Chapter four encloses an overall discussion and conclusions of the studies performed, together with the limitations and future perspectives of the work developed.

In the Appendix are included relevant documents mentioned along this manuscript. Both surveys were conducted under my supervision, with collaboration of trained personnel from the project and from local authorities[2].

(i) Nazareth T, Teodósio R, Porto G, Gonçalves L, Seixas G, Silva AC, Sousa CA (2014) Strengthening the perception-assessment tools for dengue prevention: a cross-sectional survey in a temperate region (Madeira, Portugal). BMC Public Health 14: 39.

[1] (long title) "Dengue in Madeira archipelago. Risk assessment for the emergence of *Aedes aegypti* mediated arboviroses and tools for vector control"; Ref. PTDC/SAU-EPI/115853/2009

[2] The use of « , " and ' along the document follows the criteria: « - for textual citations; " – for use a word in its uncommon context; and ' – for specific expression of this work.

ACKNOWLEDGMENTS

Tenho a sensação de que nenhuma meta é ganha só com o próprio esforço. Neste trabalho, tenho a certeza de que o que apresento aqui, tudo quanto aprendi, é resultado da interação de muitas pessoas, do encontro de muitos interesses e de muitas vontades, da junção de várias disponibilidades.
Obrigada por tanto e a tanta gente.

À minha orientadora Professora Doutora Rosa Teodósio, que aceitou o grande desafio de orientar uma Bioquímica (que pouco conhecia) numa tese de Saúde Pública,
Obrigada por essa confiança desde início.

À minha co-orientadora Professora Doutora Carla Sousa que me integrou no Projeto que coordena sobre o Risco de Dengue na Madeira, permitindo-me estudar e aprender uma realidade concreta,
Obrigada pela oportunidade.

À minha co-orientadora Professora Doutora Graça Porto que, muito para além de uma co-orientação institucional proporcionou uma mentoria essencial para o meu crescimento ao longo desta tese,
Obrigada pela disponibilidade.

Ao Programa GABBA e a todos os alunos e Professores que o compõem, em especial à Professora Doutora Maria de Sousa (fundadora), ao Professor Doutor Alexandre do Carmo (atual Presidente), à Dr.ª Catarina Carona (muito-mais-que-secretária), que proporcionam a jovens (aspirantes a) cientistas uma realidade única de aprendizagem em Ciência,
Obrigada por tornarem os valores deste programa uma realidade, mesmo sendo muitas vezes os pioneiros a fazê-lo.

Às autoridades de Saúde da Madeira, em particular à Enfermeira Ana Clara Silva, pela abertura de, no meio de um dia-a-dia repleto de "expediente",

haver lugar para uma reflexão científica que melhor possa servir a Saúde das populações,
Obrigada pela abertura à novidade.

A tantos especialistas de diversas áreas, que permitiram que um mesmo problema fosse pensado de uma forma inter-disciplinar: Aos Professor Doutor André Biscaia, Professora Doutora Cláudia Conceição, Professora Doutora Cristina Godinho, Professora Doutora Cristina Vaz Almeida, Dr. Júlio Borlido Santos. Eng.º Luís Antunes, Dr. Luís Xavier, Professora Doutora Luzia Gonçalves, Dr.ª Mafalda Fernandes, Dr.ª Madalena Boissel, Dr.ª Maria Minas.
Obrigada pelo contributo e pelas conversas tão interessantes.

À Fel, à Jelena, à Marta, ao Ricardo (colegas de curso de Bioquímica), ao Bruno, à Clara, à Joana, ao João, ao João, à Margarida, à Mariana, à Olga, à Sara, à Susana, ao Zé (colegas da turma da 13th edition) e tantos outros alunos GABBA,
Obrigada pelos exemplos de postura-crítica, rigor e criatividade em Ciência.

À grande equipa de professores, investigadores, alunos e funcionários do Instituto de Higiene e Medicina Tropical, que conviveram comigo nos últimos quase três anos, em especial ao "núcleo" do Grupo Carla Sousa / João Pinto: Bruno Gomes, Gonçalo Seixas, José Vicente, Patrícia Salgueiro, Vasco Gordicho,
Obrigada por todo o apoio e por fazerem do "nosso" gabinete o lugar com melhor ambiente para trabalhar!

E por ultimo a todos os que fora do meio profissional me acompanham (e são tantos), em particular, ao Luís e à sua/nossa família, à Gui, ao Tiago, ao Francisco, à Joana, aos meus pais, à Marta aci, e aos meus amigos, fundamentais para o que sou hoje e com certeza para o que serei daqui para a frente,
Obrigada por Deus nos ter cruzado num caminho comum.

RESUMO

Desde 2005, quando a presença de *Aedes aegypti* foi descrita pela primeira vez na Ilha da Madeira, o risco de emergência/re-emergência de arboviroses ganhou especial atenção perante as autoridades locais e internacionais.

Uma combinação de fatores tais como a resistência a inseticidas e a marcada sinantropia (associação com humanos) da população de mosquitos local que dificulta o seu controlo, assim como os elevados níveis de fluxo humano que ocorre entre a ilha da Madeira e outras regiões (turístico e migratório), levou à proliferação da população do mosquito e à entrada do vírus da dengue na neste território. Apesar das iniciativas de controlo vetorial realizadas pelas autoridades locais, em 2012 foi declarado o 1º surto de dengue na ilha da Madeira, que foi também o 1º registado na Europa no último século. Assim sendo, a promoção da adesão da comunidade às atividades domésticas de controlo larvar, tornou-se uma prioridade ainda maior de forma a reduzir a densidade e área de distribuição de *A. aegypti* no arquipélago da Madeira.

Este trabalho, iniciado em 2011, começou por aferir de forma representativa as perceções da comunidade local relativamente ao controlo larvar doméstico, e os tipos de criadouros larvares de *A. aegypti* existentes nas suas residências. Para isso, foi realizado um inquérito por questionário e construída uma ferramenta denominada análise de Perceção Essencial (EP-analysis). Esta ferramenta permite quantificar as perceções comunitárias numa escala de 0 – 10, discriminar o grau de integração de ideias fundamentais definidas previamente (conceitos e tópicos), e ainda estimar o grau de disseminação de perceções incorretas (mitos) na comunidade. Apesar de, segundo a EP-analysis, o nível dez (EP-score = 10) ser a máxima perceção que pode ser medida, este nível corresponde, ainda assim, à perceção essencial (mínima necessária) para a compreensão integral do comportamento proposto.

A maioria dos residentes estava abaixo deste requisito (apresentavam em média EP-score = 5), e acreditavam em média em quatro dos treze mitos

identificados. Foi verificada uma associação significativa entre o nível de EP-score e a inexistência de criadouros nos domicílios ($p<0.001$), o que assegurou a validade desta ferramenta para medição da perceção. Por outro lado, os criadouros mais frequentemente encontrados foram recipientes compatíveis com um ambiente urbano, limpo e organizado, apresentando um padrão de infestação atípico quando comparado com as regiões endémicas de dengue.

Após o término do surto realizou-se uma segunda medição da perceção relativamente ao controlo larvar doméstico. Para isso foi usada a metodologia por blocos estatísticos para emparelhar as populações femininas dos estudos realizados antes e depois do surto, garantindo homogeneidade em cinco variáveis determinantes entre os pares. Após o surto, a população revelou um aumento médio de dois valores no nível da perceção medida (EP-score). No entanto, não se verificou uma alteração significativa no número de residentes que se aproximou do nível mínimo necessário para a compreensão integral do comportamento proposto (EP-score=10). O número médio de mitos que cada residente revelou acreditar diminui para três mitos entre os doze mitos identificados após o surto. Os resultados detalhados da EP-analysis mostram um aumento da integração da maioria dos conceitos essenciais, evidenciando quais os que tiveram maior ou menor aumento.

Os métodos de análise quantitativa têm limitações conhecidas na aferição de aspectos subjectivos como perceções e portanto poderão ter uma capacidade limitada de identificação de perceções erradas (mitos). Tendo em conta que os resultados deste trabalho têm aplicabilidade direta nas políticas de prevenção, a validade das perceções medidas tem uma importância redobrada. Por estes motivos, a mesma percepção foi estudada através de sessões de grupos focais, e subsequente análise temática. Desta forma após o surto assegurou-se uma medição da perceção segundo uma metodologia mista compreendendo recolha e análise de dados de forma quantitativa (através do questionário) e qualitativa (através dos grupos focais).

Os resultados de ambas as análises, quantitativa e qualitativa, foram consistentes na identificação de perceções da comunidade que dificultam a adesão às práticas propostas. No entanto, a análise qualitativa indicou novas perceções (não identificados pela EP-analysis), que consistiam sobretudo em perceções difíceis de medir, percepções como sentimentos ou apreciações. Para além disso, a análise qualitativa permitiu uma compreensão aprofundada sobre a forma como a experiência do surto da dengue modelou aspetos cognitivos e emocionais da perceção comunitária.

No global, as principais perceções comunitárias observadas como dificultadoras da adesão às práticas propostas foram: a imprecisa perceção de risco, a descrença no controlo doméstico larvar do *A. aegypti*, e a desconfiança no envolvimento das autoridades locais para controlo da problemática.

Este trabalho constitui a mais completa descrição das perceções da comunidade acerca da prevenção da dengue em regiões de recente contato com a doença. As conclusões deste estudo vão seguramente reforçar a eficácia da prevenção em regiões endémicas e epidémicas bem como a capacidade de resposta em zonas em risco de transmissão de dengue a nível global.

SUMMARY

Since 2005, when the presence of *Aedes aegypti* was first reported in the European Madeira Island, the risk of arboviral infection emergence/re-emergence gained special attention by the local/international public health authorities.

A combination of propitious factors such as resistance to insecticides, the marked sinantrophy (association with humans) of local mosquitoes populations which hampers its larval control, and the high human flow which occurs between Madeira Island and other worldwide regions (touristic and migratory), led to the thriving of mosquito population and to the entrance of the dengue virus into this territory. Despite authorities initiatives in vector-control, in 2012 the first dengue epidemic in Madeira, and therefore the first reported in Europe in the last century, was declared. The promotion of the community engagement in the domestic source reduction activities became an even greater priority in order to reduce the density and geographical spread of *A. aegypti*'s mosquito population in Madeira archipelago.

The present work started in 2011 by representatively assessing both, local perceptions regarding the domestic *aegypti*-control, and the types of *A. aegypti*'s domestic breeding sites. For this purpose, a new tool was built and was denominated Essential Perception – analysis (EP-analysis). This tool is able to quantify community perceptions in a 0 - 10 score, to discriminate the level of assimilation of pre-defined essential ideas (concepts or topics), and even to estimate how much some erroneous perceptions (myths) are disseminated within the community. Even though EP-score = 10 is the maximum value of perception that can be assessed, it nevertheless represents the minimal/essencial perception required to fully understand the proposed behaviour.

Most of the residents were under this minimal perception requirement (an average of EP-score = 5), and believed in an average of four out of the thirteen myths which were identified. Significant association ($p<0.001$) was found between both the EP-Score level and the domestic presence of

breeding sites, assuring its validity as a perception assessment tool. Moreover, the most frequent breeding sites found were compatible with a clean and organized urban environment, presenting an atypical pattern of infestation comparing to dengue endemic regions.

After the terminus of the outbreak, a second perception assessment was performed through a randomised block design. Female populations from surveys performed before and after the outbreak were paired ensuring homogeneity in five determinant variables. After the outbreak the population have increased an average of two points in the perception measured (EP-score), but no significant change was observed in the number of residents who approximated to an EP-score=10. The number of myths believed by resident decreased to three out of the twelve myths alleged after the outbreak. Detailed results of the EP-analysis have shown an improvement of the assimilation of the majority of the pre-defined essential concepts and indicated which ones had a greater increase after the experience of a dengue outbreak.

Limitations of the quantitative analysis methods are known, in what concerns the assessment of subjective aspects such as perceptions and thus may have a limited ability to identify erroneous or impairing perceptions. Given that the present work has direct implications for policy and practice, the validity of the perceptions assessed was considered to be of particular relevance to the current research. For these reasons, the same perception was assessed also through focus groups sessions and subsequent thematic analysis. This way it was attained an assessment through mixed methods, comprising both quantitative (using questionnaire) and qualitative (using focus group) data collection and analysis.

Both quantitative and qualitative data were consistent, in the identification of perceptions that were impairing the community engagement. However, results from the qualitative data analysis have indicated some new perceptions (not identified by EP-analysis) which were mainly, the most difficult to detect, perceptions related to feelings and judgements. Furthermore, it offered an in-depth understanding of how the experience

of a dengue outbreak had modulated both cognitive and emotional aspects of the community perception. Overall, the main community perceptions observed as being hardening community engagement were: an inaccurate perception of dengue risk, a disbelief in the domestic control, and a mistrust in governmental entities involvement for the control of this health threat.

This work represents the most comprehensive description of community perceptions regarding dengue prevention in short-term dengue communities. Lessons learned will undoubtedly reinforce the efficacy of dengue prevention initiatives in Madeira and also contribute for the preparedness of other dengue risk areas worldwide.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

AEGYPTI – study area of the first cross-sectorial survey performed before the outbreak (represents the most infested *aegypti* area in 2011)

AME – admitted mosquito exposure, meaning that admitted to had been bitten by mosquitoes

CBPR – Community-based Participatory research

COMBI – Communication for Behavioural Impact

DDT - dichlorodiphenyltrichloroethane

DEC – dengue endemic country(ies).

DF – Dengue Fever (classical dengue form)

DHF – Dengue Haemorrhagic Fever (severe dengue form)

EP – Essential Perception

EPPM – External Parallel Process Model

Extended-AEGYPTI – study of the second cross-sectorial survey performed after the outbreak (represents the most infested *aegypti* area in 2012 and the most affected by the dengue outbreak)

FGS – Focus Group Session(s)

HAPA – Health Action Process Approach

KAP – Knowledge-attitude-and-practices (survey)

PRE-outbreak survey – EP-analysis applied to results from questionnaire survey performed before the outbreak (Study 1, Part 1)

POST-outbreak survey – EP-analysis applied to results from questionnaire survey performed after the outbreak (Study 2)

WHO – World Health Organization

YF – Yellow fever

CHAPTER I: GENERAL INTRODUCTION

DENGUE – AN ARTHROPOD-BORNE DISEASE

Arthropods ("jointed feet" in Greek) are members of the Phylum Arthropoda which comprises invertebrate animals having an exoskeleton, a segmented body, and jointed appendages. The first signs of their existence date back to the Cambrian era, around 550 millions of years ago [1]. Through evolution, some arthropods developed blood-suction ability, a main *via* of protein acquisition from vertebrates, called hematophagy. Some pathogens can proliferate inside arthropods and during their blood meal are transmitted from arthropods to vertebrates and vice-versa. Out of the approximately 14 000 identified arthropod hematophagic species, some became carriers of relevant pathogens, contributing to their biological and geographical dispersion. By definition, when transmission implicates a pathogen replication or modification inside the arthropod, is called biological transmission, and the intermediary arthropod who carries the pathogen is called vector[3] [2,3]. Pathogens biological transmission can occur not only horizontally through blood feeding activities, but also, although less frequently, horizontally by venereal transmission (during vector mating) or vertically from an infected female vector to their offspring [4]. Vectors are mainly arthropods but fomites or rodents can also carry pathogens from one host to another. Within the Phylum Arthropoda various *taxa* may transmit several types of infectious agents, recognized as pathogenic to humans. Important arthropods-borne diseases are: malaria, sleeping sickness, leishmaniosis (all caused by protozoans), plague, lyme disease (caused by bacteria), dengue, yellow fever and west Nile fever (caused by viruses). Previously mentioned diseases are transmitted by arthropods such as, mosquitoes, fleas, flies, sand-flies (all from the class of insects), but also ticks (from Acari class) [1].

[3] The term «carriers» in epidemiology mean rather asymptomatic individuals who silently carry a disease agent

AEDES AEGYPTI – THE VECTOR

Aedes (Stegomyia) aegypti (Linneaus, 1762) is an example of a very effective vector of human pathogens. This arthropod is a member of the Class Insecta, Order Diptera, Family of Culicidae, whose specimens are commonly called «mosquitoes». Mosquitoes represent the group of insects with greater medical importance. There are approximately 3500 mosquito species spread in all continents with the exception of Antarctic and a few Islands. Specimens can be found from areas located under sea level and until 3000 meters of altitude [5].

Biological, ecological and behavioural feature

Aedes aegypti's high capacity as a human diseases vector is mainly achieved by its biological, ecological and behavioural features that promote a close association with humans. As any hematophagic anautogenus species, *A. aegypti* females need a blood meal in order to mature their eggs prior to oviposition (while hematophagic autogenus species can perform at least one oviposition without needing a blood meal) [1]. For *A. aegypti* these blood meals occur mainly indoor (endophagic feeding habits), and humans are the mosquito favoured host (anthropophilic behaviour) [6]. However, in the case of human-host unavailability mosquito females can chose to feed in other vertebrates. Unlike females of many other species, *A. aegypti* females are day-biting mosquitoes. They often have a multiple-host feeding during a single gonotrophic cycle (period since the beginning of a host search until oviposition), increasing, this way, both the probability of becoming infected and the number of potential transmissions when infected [4]. Their contact with humans is also promoted by its endophilic habits (rest inside human dwellings). Thus, due to its high association with humans *A. aegypti*, is therefore considered a synantropic or, more commonly, a "urban" mosquito [6].

Aedes aegypti's life-cycle

Similarly to almost all mosquitoes, this species have a development cycle comprising an aquatic immature phase and a terrestrial adult one. During the former, mosquitoes turn from eggs into larvae and then from larvae into pupae, before becoming an adult flying mosquito. Consequent to its association with humans *A. aegypti*'s females tend to lay their eggs preferably inside or around human houses. Places with accumulated water where oviposition occurs are named breeding sites. Common *A. aegypti* breeding sites are tyres, water tanks, buckets, flower vases or any other small and artificial containers which accumulate water; contrasting with the natural breeding sites of other sylvatic species [4,6]. Its dispersal range in urban environments is usually less than 25 meters, though females can increase her flight distance to lay eggs if breeding site's unavailability do require so [7,8]. Eggs are laid in the water surface or close to it. After oviposition and when in contact with water, eggs hatch into larvae [9]. *Aedes aegypti*'s eggs can diapause, meaning that they can lie dormant in dry conditions for periods of up to one year and hatch when water and food is available. Larval feeding relies on organic matter present in the breeding site, while pupae is a quiescent phase. The adult *A. aegypti* longevity is rarely precisely estimated varying according to humidity, temperature and available food (nectars in the case of males and also blood meals for females) [10]. Some author state that it ranges from eight-to-fifteen days for females and three-to-six days for male, other claim that adult culicidae mosquitoes in temperate regions may live up to five weeks [1,10].

Adult *A. aegypti*, is a dark mosquito of easy identification due to its specific thorax's white strips which resembles a lira (Figure I.1). Its white-striped legs are also very typical, and explain why it is regularly called as «white legs» by some communities of endemic areas. However, this feature is not specific *to A. aegypti*' being also present in individuals of the related *taxa*, (*e.g. Aedes albopictus* (Skuse,1894)).

FIGURE I.1 – *AEDES AEGYPTI* PHYSICAL APPEARANCE [11]

Invasiveness and geographical spread

One of the most alarming *A. aegypti*'s feature is its high ability to colonize new territories. Some invasive vectors disperse into new habitats by flight or wind, however *A. aegypti*'s geographic expansion is usually human-mediated. *Aedes aegypti* perfectly combines the desiccation-resistant eggs with its synanthropic behaviour. This way it not only can travel with humans (either in egg or the adult form), having access to territories miles away from their origin place, but also profit from the highly-moderated microenvironments that human domestic areas provide [6]. This explains the current *A. aegypti's* geographic distribution.

Originated in West Africa, the subspecies *A. aegypti aegypti* evolved from a sylvatic ancestor *A. aegypti formosus*. Its spread most probably started during the Portuguese expeditions which around 1500's established trading routes from West Africa to Europe, Americas and Asia [12]. Breeding in ship´s water reservoirs or persisting as dessication-resistant eggs, *A. aegypti* resisted to long maritime travels, being introduced into the almost the rest of the world. Changes in *A. aegypti* feeding and

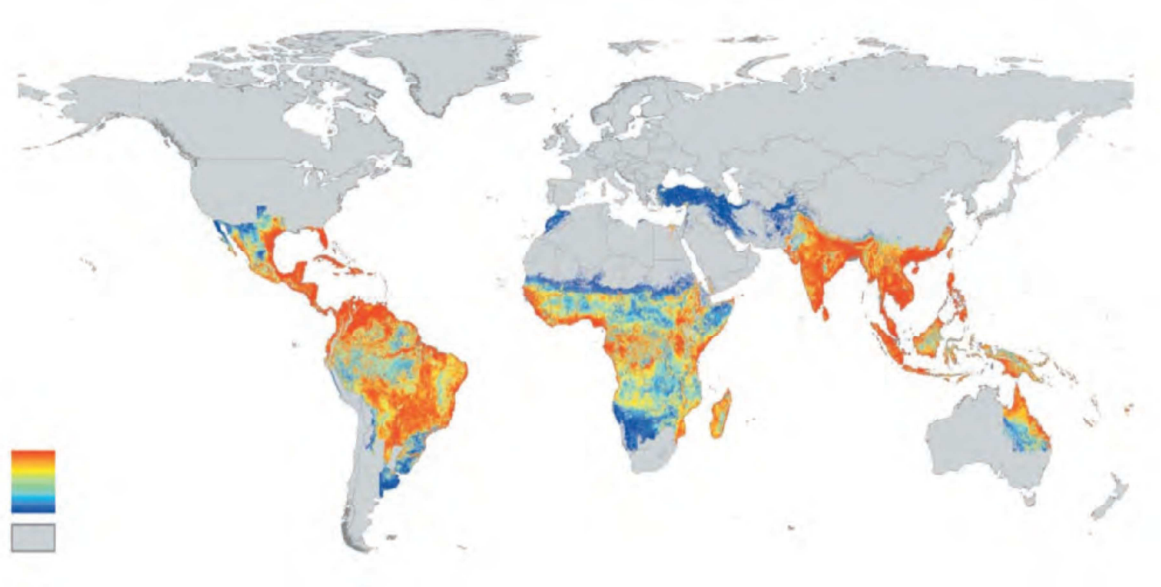
breeding habits were undoubtedly crucial for its settlement in urbanized areas.

Local reports and studies on genetic variation suggest the *A. aegypti*'s introduction in Asia did not occur until late in the nineteenth century [7,11].

Currently, *A. aegypti* is established worldwide in regions located between the northern January and southern July 10 ºC isotherms. All territories positioned between these isotherms, are areas of potential risk for *A. aegypti*'s infestation (Figure I.2) [6].

FIGURE I.2 – DENGUE RISK MAP

Suitability of dengue transmission is gradually described from high (in red) to low (in dark blue), grey areas are unsuitable or non-endemic [13].



Other Aedes species

Besides *A. aegypti*, several species of the *Aedes* genus, are described to be vectors of important pathogenic virus, such as *A. albopictus, A. atropalpus*, *A. atlanticus* or *A. dorsalis*. Out of those *A. aegypti* and *A. albopictus* are the most remarkable regarding their medical importance. In contrast with *A. aegypti*'s human preference, *A. albopictus* females feed upon all kind of mammals, and can also feed on reptiles, birds,

amphibians and most groups of vertebrates (opportunistic and zoonotic feeding habits). Moreover, *A. albopictus*'s breeding sites are very broad being either natural (such as tree holes) or artificial (water storage containers and other *A. aegypti* breeding sites). In advantage to *A. aegypti*, *A. albopictus* has the ability to adapt to cold temperatures by becoming dormant during the winter of temperate regions. This aptitude favours its invasiveness to northern areas or high-altitudes territories [14].

Medical importance

Aedes aegypti is the main vector of three important viral infections: dengue, chikungunya and yellow fevers.

Yellow fever (YF) is the original viral haemorrhagic fever known, and was for several years the most fatal, with mortality rates as high as 50% [15]. With the arousal of a highly effective vaccine in 1936, the number of cases decreased abruptly. Financial and logistical vaccination constrains in development countries combined with the growing international travelling had caused an increase of its incidence in last thirty years. Recent estimations count 200 000 persons annually infected by YF in tropical regions of Africa and South America [16].

Chikungunya virus can be transmitted by both *A. aegypti* and *A. albopictus* vectors. The first chikungunya's epidemic outbreak occurred in East Africa around 1950's [17]. Now-a-days this infection is enzootic/endemic (permanently present) in Asian and African tropical regions. Recently (2007) it has been introduced in Europe and then in the Americas, where only during March 2014 has been over 8000 suspected cases [18,19]. Due to its current huge worldwide dispersion there are not accurate global prevalence estimations. Chikungunya only rarely causes mortality being commonly considered a non-fatal disease [20].

Presently and comparatively to YF and chikungunya, dengue has the higher global prevalence and the larger geographic distribution [21]. Moreover, unlike YF, it still lacks an effective vaccine or specific anti-viral therapy. Consequently out of these three *aegypti*-transmitted diseases, dengue is currently and undoubtedly the most threatening.

DENGUE – THE DISEASE

Dengue was an important global disease in the 18th century, and is currently still considered by WHO the major human arboviral infection worldwide [21].

Origin and History

The first records of a disease with symptoms compatible with dengue were made in China as early as the period 265-420 AD. Major dengue-resembling epidemics have been described in West Indies (in 1635), in Central America (in 1699) and in North America (in 1780 and 1945). Dengue-like clinical illnesses were also described in Australia, Caribbean Islands and in Europe (eventually from returned colonialists from tropical Asia and east Africa). Only after the isolation and characterization of dengue viruses, in early 1900's, it was possible to attribute past records to dengue infections [7,16]. The uncertain origin of the term «dengue», registered almost contemporaneously as «Ki-dinga pepo» in east Africa, as «dandy» in English colonies and as «dengue» in Cuba and Spain, also confirms its past global spread. Even though the meaning of the dengue term is not perfectly understood, the alternative and previous name «breakbone fever» comes most probably from the dengue-associated bone, muscle and joint pains or from the profound fatigue that it can cause for several weeks after recovery [7,17].

Virus, clinical feature and pathology

Now-a-days it is known that dengue is an arbovirose caused by the homonymous virus. Dengue is a single-strand RNA virus member of the genus Flavivirus/family Flaviviridae. There are five different described dengue virus serotypes: DEN-I, DEN-II, DEN-III, DEN-IV and DEN-V, whose single infection results in lifelong immunity to that specific serotype [17,18]. However, cross infections between different serotypes, result in only partial and temporary immunity. Moreover, subsequent dengue infections of different serotypes, even when separated by many years,

increase the probability of developing severe dengue form, denoted as dengue haemorrhagic fever (DHF) or simply severe dengue. Some dengue virulent strains can also cause these severe forms of dengue. Most of the dengue virus infections are asymptomatic and the symptomatic ones present a wide range of clinical manifestations [7,17]. Classic dengue fever (DF) is a flu-like illness characterized by high fever (40°C/ 104°F) accompanied by at least two of the following symptoms: severe headache, pain behind the eyes, muscle, bone or joint pains, and rash [19,20]. Severe dengue (or DHF) also cause abdominal pain, bleeding or breathing difficulty [24]. This occurs usually during two-to-seven days, following three phases, an initial febrile phase, a critical phase when death can happen, and a spontaneous recovery phase.

Dengue severity (DHF) is derived from the disorder of the vascular permeability, eventually caused by alterations on the glycocalyx layer of the endothelial cells. This condition, lead to low blood pressure, loss of clotting proteins and platelets. It is thought to be trigged by an antibody-dependent enhancement which is coherent with the higher risk of these severe forms to occur in secondary cross infections. However, this is not entirely understood mainly due to the lack of an animal model to study this clinical feature [7,17]. Mainly caused by a huge hypotension, dengue severe forms are sometimes fatal (in 1-10% of the treated cases and in approximately in 30% -50% of the untreated ones). There are no vaccines or specific anti-viral therapy currently available to treat dengue infections. Survival rates increase with prompt clinical diagnosis and appropriate clinical management of patients' intravenous hydration [21].

After a dengue-infective mosquito bite, the virus replicates in the human host during the so-called intrinsic incubation period. This generally lasts two-to-seven days but it can last until fourteen days. Only then, when human's viremia is high, transmission can occur from humans to uninfected mosquitoes. The symptoms' onset usually start simultaneously with this viremia peak. In the mosquito, the virus replicates and reaches the salivary glands in four–to-ten days (extrinsic incubation period). After

being infected mosquito is able to transmit dengue for the rest of its life, continuing the cycle of dengue transmission [7,16,17].

Global current scenario

Dengue is present in more than 125 endemic countries distributed throughout all WHO regions (Southeast Asia, Western Pacific, Americas, African, European and Eastern Mediterranean regions). A total of 3.6 billion people are estimated to live in risk of having dengue virus infection [21]. Recent cartographic studies suggests a total of 390 million dengue infections to occur annually worldwide, of which 96 million are severe forms [25]. A total of 20 000 annual deaths are reported but this number is considered to be underestimated. Children are believed to be the most affected by dengue mortality and morbidity [26].

Moreover, dengue also involves a huge economic burden. Studies about the annual aggregate cost in groups of countries are consistent: 2.1 billion American dollars (estimated in all nations of Americas) [27], 950 million American dollars (estimated in 12 southern-east Asian countries) [28], 1.8 billion international dollars (estimated in eight countries either Asian or American) [29]. These costs would be even higher if covering prevention or vector control expenditures, excluded in the previously mentioned studies. Productivity loss was, in fact, the main instalment of dengue costs. The annual global disease burden can also be measured in 700 000 disability adjusted life years (DALYs), which measures the sum of years of potential life lost due to premature mortality and the years of productive life lost due to disability [30].

These recent dengue burden estimations, especially in what concerns its global prevalence, which are more than three times the previous estimations of the World Health Organization, provided a triggering point for a wider discussion about dengue global prevention and control.

Moreover, looking at *A. aegypti's* previous infested areas and its current climatic distribution it's clear that *A. aegypti* is still far from its maximum geographical dispersal [6]. Examples of territories which are at risk of *A.*

aegypti infestation are Europe, North America and part of Australia that had already been highly-infested in the past [6,11].

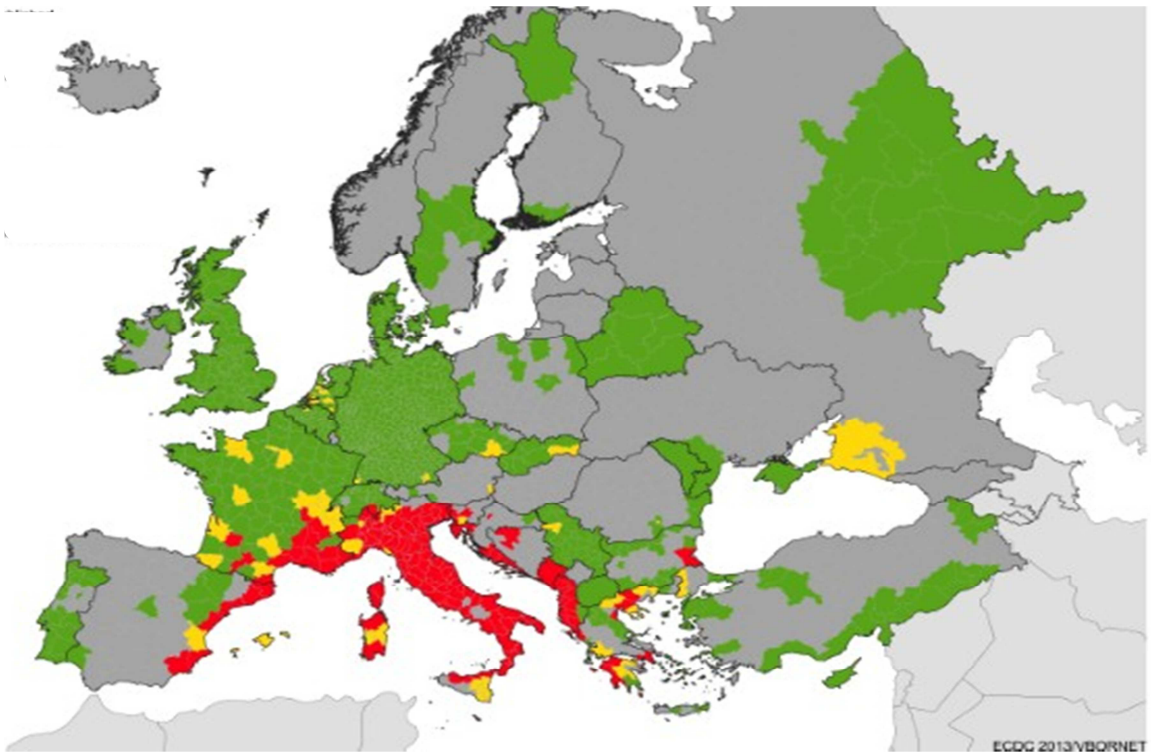
Aedes aegypti in Madeira Island (Europe)

In 2005, triggered by population complaints about a nuisance mosquito, *A. aegypti* specimens were found for the first time in Madeira, an Atlantic Portuguese archipelago [27,28]. Despite authorities' efforts through educational and vector-control strategies, during subsequent years the species thrived in the island, increasing the risk for local dengue emergence [33]. In October 2012, the first dengue outbreak was declared in Madeira Island which was also the first dengue epidemics in Europe after almost 100 years [30,31]. Until March 2013, when the outbreak were considered finished, there were notified 2168 DF cases (DEN-I), zero severe dengue (DHF) cases and 81 imported cases from Madeira to European countries [36].

Madeira Island is the biggest inhabited island of its homonymous archipelago. This European island is characterized by mild temperatures (average temperatures range from 16.1 ºC to 24.7 all over the year). Out of their 263 091 habitants more than 40% live in the major county, Funchal, where the population density is as high as 1433,5 habitants per square kilometres [37].

Currently, Madeira, is at risk of a second dengue outbreak. Also, being a highly touristic destination, Madeira also constitutes an open door for dengue virus introduction into non-endemic *albopictus*-infested regions such us Europe and North America (Figure I.3) [35,36]. Moreover, according to the European Centre of Disease Prevention and Control (ECDC), if re-introduced in Europe mainland, *A. aegypti* would most probably find adequate climatic conditions to become widely established [37,38].

FIGURE I.3 – AEDES ALBOPICTUS DISTRIBUTION IN EUROPE
Color Scale: Red – regions where *A. albopictus* is established; Yellow – regions where *A. albopictus* was recently introduced; Green - regions where *A. albopictus* is absent; and Grey - no data regarding *A. albopictus*'s current vector surveillance is available [42].



DENGUE PREVENTION, CONTROL AND RE-EMERGENCE IN THE PAST

HISTORY OF THE DENGUE PREVENTION

Several and crucial issues about dengue current prevention, control and re-emergence can be understood looking at how it evolved in the past.

Successes (1900-1970)

Although until 1970's there were no dengue specific campaigns, dengue have disappeared from Americas and Europe before that by taking indirect advantage from the vector-control implemented during malaria and yellow fever campaigns in these territories.

Until 1900's dengue was not recognized as a mosquito-borne infection. The discovery that those responsible for causing yellow fever and dengue were filterable agents transmitted by *A. aegypti* occurred in 1903 [40,41].

After this discover vector control strategies started to be studied, planned and implemented for the first time by the YF commission in Cuba and by the physician and bacteriologist Oswaldo Cruz in Brazil [40,41]. In this period, mainly due to the absence of the yellow fever vaccine, and the inexistence of multiple dengue serotypes co-circulation, South America YF incidence and mortality rates were much higher than the dengue ones. Vector control strategies were performed to prevent yellow fever epidemics and were based on the elimination of *A. aegypti's* breeding sites (source reduction). This led to a dramatic decrease of YF cases in the Americas. Based on the source reduction outcomes in the YC control, the Rockefeller Foundation encouraged a campaign to eradicate it from the western Hemisphere. By 1925 a small coastal Brazilian area was the only recognized YF endemic area remaining in the Americas [43].

However, in 1928 Brazil suffered another big YF epidemic, most probably caused by the decline of the vector control strategies (after almost 20 years of YF control) and the presence of a sylvatic YF virus reservoir. In 1930, with the appearance of an effective YF vaccine, campaigns to control *A. aegypti* were even more abandoned. After 1945, with the advent of dichlorodiphenyltrichloroethane (DDT), a powerful insecticide *A. aegypti* control in Americas persisted through an approach alternative to source reduction [44]. The DDT seemed to be a quick and effective way to control *A. aegypti*, compared with the time-consuming source reduction practices that moreover needed long-term sustainability to be effective. From 1946 until 1970, the Pan American Health Organization (PAHO) coordinated DDT-spraying campaigns which led to *A. aegypti*'s almost complete disappearance from Americas [45]. The World Health Organization (WHO) also coordinated DDT-based massive campaigns to control malaria, attaining its eradication in North America, Soviet Union, Europe and North Africa between late 1950's and 1975 [46]. *Aedes aegypti* had also disappeared from these territories during this post-World War-II period. Even though its eradication in North America and Europe was not planned and it is not well described, it most probably occurred simultaneously to eradication of the malaria vector through the effect of DDT [46].

Few or none reports describe dengue prevention in Asia and Africa in this period. From 1940 to 1970, Africa saw a vaccine-based effective YF control undertaken by the French and the Rockefeller YF Commission [43]. Inexistent or poor mosquito control activities were performed against *A. aegypti* and other sylvatic *Aedes*-species. In Asia, for reasons that are not clear yet, yellow fever has never been recorded and dengue first became an important health threat in late 1950s, when the increased transmission of multiple serotypes resulted in the emergence of DHF epidemics [40,43].

Failures (after 1970)

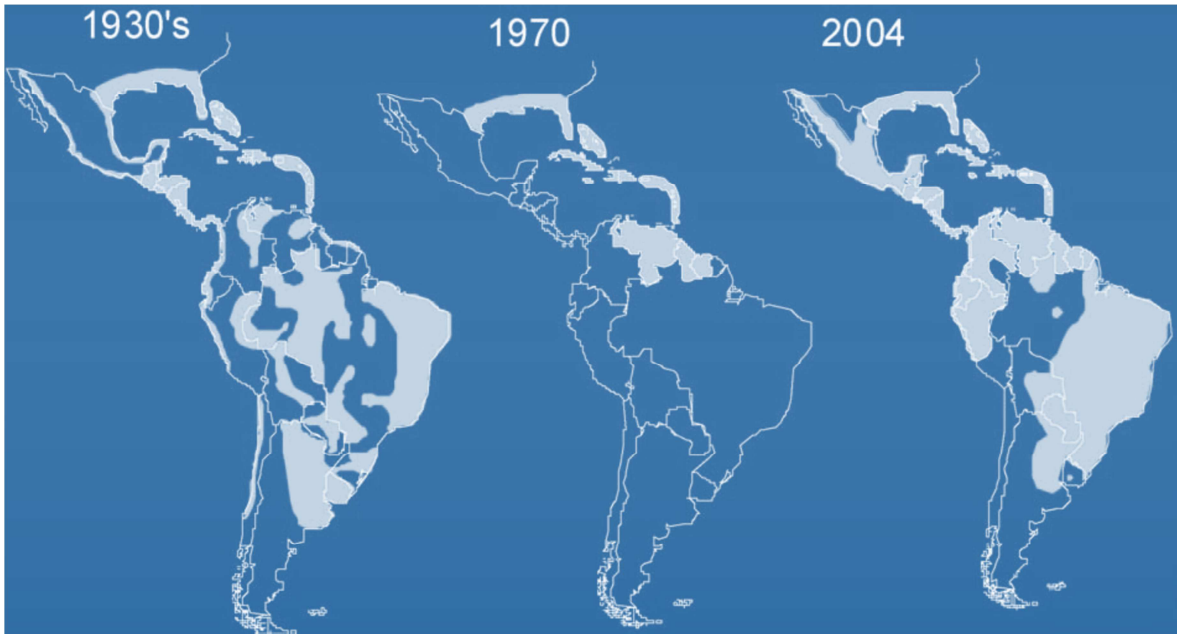
If until 1970's dengue burden was veiled by other major vector-borne diseases, since this decade it had proved to be a major health threat. In America and also Africa DDT was starting to be implemented, but DDT-based campaigns began to fail. This condition, mainly caused by the emergence of insecticide resistance to DDT within the *A. aegypti* populations, may have contributed to the re-infestation of Central and South America by this species. Dengue outbreaks became, thus, more frequent and with higher mortality rates. During this decade different dengue serotypes started to co-circulate, arriving from Africa and Asia, causing severe dengue cases. In 1981, the first main DHF outbreak in the Americas occurred in Cuba, with 10.312 DHF cases [47]. Additionally, the increasing international air traffic and the unplanned grow of urban areas have promoted dengue serotypes circulation and its increased transmission during outbreaks.

Since *A. aegypti* control programs had lost political interest with its eradication, they were at this time hard to re-implement. Moreover, when re-introduced, *A. aegypti* have found breeding-site-enriched environments, consequence of the abandonment of source reduction activities several years ago. Even when implemented, governmental source reduction activities were ineffective due to the mosquito population densities that, in the meanwhile, have increased tremendously. These populations have also established themselves in urbanized areas where their control was much

more difficult. Consequently during several decades source-reduction campaigns were often inefficient [40,41,43].

In conclusion, although until 1970's there were no dengue specific campaigns, dengue had probably disappeared from Americas and Europe due to vector-control programs implemented during malaria and yellow fever campaigns in these territories. After 1970, mainly due to source reduction activities abandonment and to DDT-resistance arousal *A. aegypti* re-infested the Americas (Figure I.4).

FIGURE I.4 – GEOGRAPHIC DISTRIBUTION OF *AEDES AEGYPTI* IN THE AMERICAS IN 1930, 1970, AND 2004
(infested areas are represented in white) adapted from [43].



LESSONS ABOUT RE-EMERGENCE: CLIMATIC OR BEHAVIOURAL CAUSES

The increasing worldwide re-emergence of dengue and other mosquito-borne diseases is commonly attributed to climate changes. This results from the assumption that warmer global temperatures will increase mosquito proliferation and geographic range, which may not be entirely true [45,46,47]. In fact, ecology, development, behaviour, and survival of mosquitoes as well as the transmission dynamic of pathogens, strongly depend on climatic factors. Temperature, rainfall, humidity are the most

determinant variables but also wind velocity and photoperiod can also be influential. Simultaneously the weather also influences pathogens, namely in their rate of multiplication in the mosquito, the rate of infectious bites, and consequently the likelihood of successful transmission to another host. Changes in mosquitoes and pathogens survival can only result in increased transmission rates if the development time of the pathogen does not exceed the life span of the mosquito. There is, thus, a complex interplay of several factors determining the overall effect of the climate on local prevalence of mosquito-borne diseases. Furthermore, general climatic observations may not reflect the local microclimates experienced by mosquitoes, mainly by the synantrophic species which live in human-modified habitats. By these reasons, several studies reject future scenarios for mosquito geographical distribution based exclusively on climate conditions [6,43].

Moreover, the history of dengue prevention and re-emergence revealed that climate has rarely been the principal determinant of their prevalence or range. As explored in previous sub-section, examples of the main causes of dengue re-emergence after 1970 were: the lack of long-term sustainability in source-reduction activities, the increased population density, the growth of urbanized areas, the rising of international mobility (touristic and trade) and the spread of insecticide resistance in mosquitoes. Lessons from the past show that social and behavioural factors have a significant role on dengue incidence, suggesting behaviour-oriented strategies for vector control regardless of future climate change [46].

Accordingly or coincidently, in 1970's an extensive discussion within the public health field emerged. Due the recognition that: (i) many diseases are related to unhealthy lifestyle, (ii) health costs with treatment are higher when compared with diseases prevention, and (iii) the increasing global population lead to a weakening of both the healthcare resources and the sustainability of vertical interventions, a new area of study called Health Promotion has arouse [51].

HEALTH PROMOTION

DEFINITION AND SCOPE

Health promotion, emerged in the 1970's / 1980's to respond to the need of re-think the social model of health [52].

Considerable time and effort have been spent in defining it and in identifying its scope and boundaries. This debate still persists, especially in the delineation of the role of several branches of knowledge and disciplines on which health promotion was based, mainly: psychology, sociology, epidemiology, education, communication and social-marketing. All of them require the definition of specific terms which brought to the health promotion arena several new concepts. This condition can help to clarify health promotion scope but simultaneously hamper its understanding by requiring a hard semantic discussion. The interplay between health promotion and these intersecting disciplines is still not consensual, having been defined as complementary disciplines to health promotion or as part of it as a whole inter-sectorial discipline.

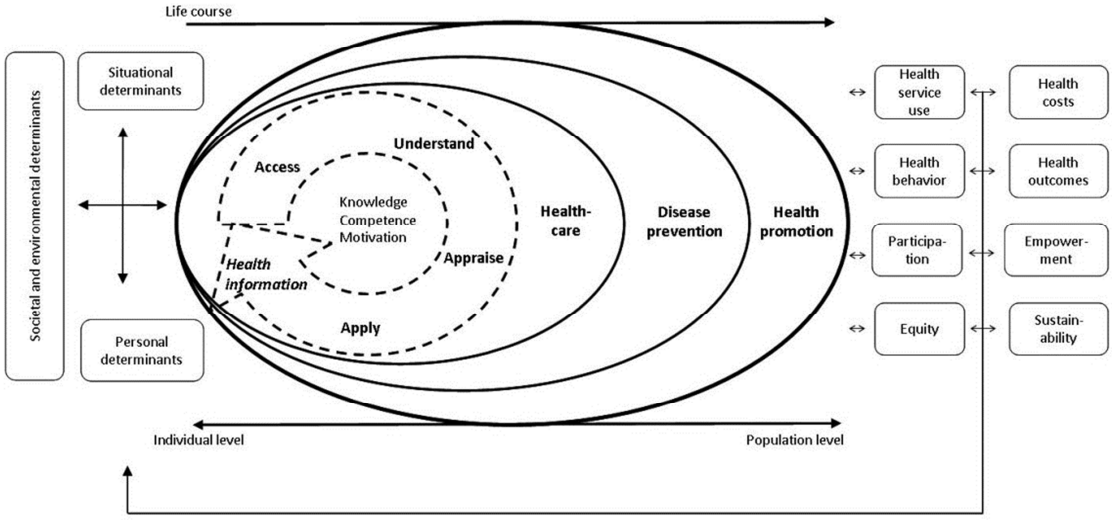
The first official appearance of «health promotion» term was as a key health strategy proposed by the Canadian health minister in 1974 [53]. In 1986, the American Journal of Health Promotion defined it as «the science and art of helping people change their lifestyle to move toward a state of optimal health». Subsequent considerations tried to turn it into a broader definition, such as the one defined in the same year at the important Ottawa WHO-coordinated conference on Health Promotion: «the process of enabling people to increase control over, and to improve, their health», including «a focus on individual behaviour» and «a wide range of social and environmental interventions» [54]. This definition is still accepted by WHO.

Currently several conceptualizations on health promotion still persist but all share some key elements. One of those is its focus on stimulating the adoption of healthy behaviour among individuals or communities [55].

The adoption of conducts performed for the purpose of promoting, protecting or maintaining health (health behaviour) and the

discontinuation of specific behaviours that are proven to be associated with increased susceptibility to a specific illness (risk behaviour) will ultimately prevent disease (Figure I.5) [56].

FIGURE I.5 – INTEGRATED MODEL OF HEALTH PROMOTION [57]

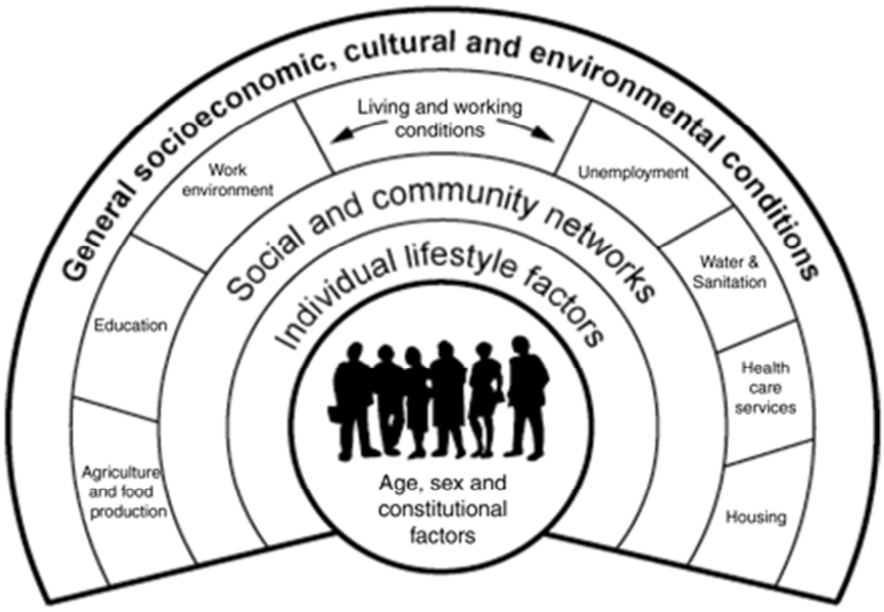


In this sense, health promotion overlaps disease prevention even though it (rather than prevention) do not deal with individuals and populations with identifiable risk factors. Therefore, prevention of major causes of death of both non-communicable and infectious diseases, rely on the promotion of healthy behaviours, such as physical activity, fruits/vegetables intake or appropriate use of antibiotics. In the last 50 years, psychology had extensively contributed to clarify different ways of (healthier) behaviour acquisition by individuals [58].

Strategies for Behavioural Impact: rational or intuitive approaches

Health behaviours are determined by several of variables, mainly by socio demographic characteristics [59]. However since majority of these variables are not easily changeable, studies regarding healthier behaviours focused in other health determinants related to behavioural variables (Figure I.6).

FIGURE I.6 – THE MAIN DETERMINANTS OF HEALTH [60]



During several years, knowledge has been considered the sole or the most determinant factor for behaviour change. This was the basis of the first health education campaigns. Nevertheless, both scientific studies and historic evidence have refuted this theory. Very few studies showed a correlation between community knowledge and their behaviour [58-61], and moreover health education campaigns have ultimately failed. Public reactions were frequently interpreted as irrational. Health-educators who provided to the public the logic arguments to convince them to change behaviour did not understand why public compliance was low. One paradigmatic example is what happened with smoking campaigns [63].

In 1974, the Health Belief Model proposed that community's beliefs and perceptions were critical for behaviour change [64]. The acceptance of this model triggered the search for the process to achieve behavioural impact (changes in behaviour). From the 1980's until the present several models and theories were developed to try to better explain how people perceive and react to health-seeking behaviour proposals. Relevant examples of those are the Social Cognitive Theory [64,65], the External Parallel Process

model (EPPM) [67], and the Health Action Process Approach (HAPA) [68]. These and other theories suggested that concepts like 'risk perception' (in the health context, the degree to which a person feels his/her health at risk), 'self-efficacy' (one's confidence in one's ability to take the recommended health-promoting actions) and 'action outcome' (one's belief that the recommended action will have an effect in his/her health) have behavioural impact [68,69]. These determinant variables seem to produce a motivation to adhere to healthier behaviours (precautionary motivation) that would (or not) lead to an intention to perform it. Moreover, following the HAPA model, only when the perception developed leads to an intention (recognized if people perform planning activities), it will end in an effective behavioural change, and afterwards in its eventual maintenance.

Now-a-days it is, hence, well understood that, to be effective, health-promoting campaigns not only need to explain why changing behaviours is beneficial, but also should take in consideration the community's beliefs (beliefs in the threat suffered, in their own abilities, and in the effectiveness of the proposed change). Nonetheless, one's beliefs rely on not only on what one has heard but also on what one has experienced. Recently and accordingly, "past experiences" have been increasingly stated as being crucial in decision-making. Countless authors claim that due to the type of emotions, affects and intuition that they produce, past experiences can strongly (dis)encourage a particular action [70-75].

Altogether, these contributions present two different ways to explain how humans perceive and take decisions: one analytical and one experiential [70,71]. In the former, people use logic, reason and intelligent deliberation and thus, meaningful messages can be decision-promoting. In the latter, decision is based on past experiences, in the emotions/affects that they have caused and thus, emotional or intuitive messages most likely lead to the decision.

Numerous studies have shown a correlation between the previous mentioned rational variables (*e.g.* self-efficacy, risk perception and action outcomes) and the consequent outcomes in behaviour changes, confirming

thus its role in the way people perceive and react to behavioural proposals in a (health) risky context [76-79]. However, few studies explore how past experience influence public perceptions and reactions. Evidence which would be brought by these type of studies would be of great value for those planning behavioural impact campaigns [76].

The role of the community

According to WHO, community is a «group of people that may or may not be spatially connected, but who share common interests, concerns or identities». It could be local, national or international, with specific or broad interests, health determinants or socio-demographic features [56].

The community have a dual role in health promotion. First, as its general target since health promotion focuses on changing community behaviours. Second, as a crucial intervenient of health promotion that may actively contribute to health planning in general and to their own behavioural change in particular. In fact, on one hand, through communication and social-marketing methods, health promotion explores attractive and effective ways to transmit messages which promote healthy behaviours (health-seeking messages). On the other hand, health promotion aims to achieve this impact in behaviour through voluntary individual choices rather than through prescriptive impositions. For this purpose, health education is critical in guiding the community in achieving health-literacy and health-empowerment [58]. The former represents «the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health»; and which strengthens the latter, «a process through which people gain greater control over decisions and actions affecting their health» [56].

Several strategies had been developed in order to promote this aimed community involvement. Community assessment surveys which explore community's knowledge, perceptions, beliefs and opinions rapidly became a relevant strategy to concretize both community roles. By one side it provide crucial information for guiding the effective communication when

promoting behaviours. By another side, it allows the integration of the community's views when deciding health measures or planning health interventions [77].

The community's role was also focused by other approaches and methodologies such as Community-based participatory research (CBPR) and Communication for Behavioural impact (COMBI). These and other approaches /methodologies will be explored in the next section.

METHODS, METHODOLOGIES, TECHNIQUES OR MODELS

Another important theme commonly accepted within all health promotion experts is the relevance of systematic and planned actions [78]. After years of research, several methods, methodologies, techniques or models have been developed in order to: (i) translate health promotion principles into practice (ii) do it in a replicable and evaluable way, and (iii) accurately compare and evaluate interventions. Examples of relevant standardized designs are mentioned in the following paragraphs.

The **community assessment surveys** which, as previously mentioned, is a method for improving community's involvement, can be performed through quantitative or qualitative methodologies. Conclusions of the former rely on objectivity, validity and reproducibility, while within the latter, knowledge is gained by inter-subjectivity among researchers and the object of the research [79]. These epistemologically opposite approaches have divided researchers. By one hand the deductive feature of the quantitative approach can be criticized by close the research to unexpected results and not fully detect them. By other hand, the inductive feature of the qualitative one can be censured as positivist and experimental. Although the choice of the research approach is ideally determined by what one is trying to study, the combination of both can take advantage of the potentialities of each approach. This is the basis of the Mixed-methods research whereby quantitative and qualitative data collection analysis strategies are combined, connected or integrated to

provide conclusions regarding the same research question or aim. Standardized quantitative questionnaires are the prime example of the first, focus-group or deep interviews are examples of the second, and mass-media content analysis is a quantitative-qualitative hybrid methodology [77]. Mixed-methods research can follow extensive typologies varying in several aspects such as research design, sampling methodology, methods integration and research function [80]. Their selection should be in accordance with research questions and objectives.

Questionnaires (a quantitative methodology for community surveys)

A questionnaire survey is a technique to collect data from a particular community (population sample) in order to produce generalizable results. It comprises a list of questions regarding the topic of interest [81]. Questionnaires may be self-completed (in person, through mail, or e-mail) or fulfilled by an interviewer who strictly follows the questions in the inquiry (face-to-face or by telephone). Questions can be closed or open according to whether or not they present previously defined multiple-choice answers. Although the disparate results which may be obtained from these two types of questions, there is no consensus concerning which one generates the most valid results [86,87]. Open questions applied to big representative samples can guide the subsequent construction of multiple answers options for a similar closed question. Considerable literature explores techniques which contribute to the construction of adequate and unbiased surveys apart from the selection of the type of questions [85,87,88]. To achieve the first condition it is fundamental that the questionnaire construction ensures its reliability (ability to produce the same results in equivalent repeated applications) and its validity (ability to measure what is actually intended to be measured). For reaching the second condition, attention should be given to avoid what may empathize the difference between what is answered by

respondents in a particular question and what is their "real" knowledge/perception/opinion regarding that question (bias) [87,88]. Examples of common bias are the tendency of respondents to give social accepted answers or the influence that the order of the questions can have in the answers given in the course of the questionnaire.

The analysis of data collected through questionnaire surveys can be as simple as the description of the frequencies of each answer (which implicates the establishment of categories for the open questions) [83]. However questions which intend to measure latent variables (which cannot be directly measured) require, therefore, a more complex analysis. These variables can be indirectly determined by the measurement of several related measurable variables, and by the use of assessment scales as the type of answers for each measurable variable.

Examples of latent variable are satisfaction or social attitudes. The latter is frequently measured in public health through the commonly called knowledge-attitude-and-practices surveys (KAP surveys) [84].

Focus group (a qualitative methodology for community surveys)

Focus group is a technique to collect data based on discussion sessions within small groups of individuals regarding a topic of research interest [85]. Being qualitative, this technique instead of objective estimations provides not only the identification of values, beliefs, perceptions, judgements and opinions but also their interpretation. The group of individuals participating in a focus group session (FGS) is frequently conveniently selected combining individuals of different socio-demographic characteristics except in at least one variable which should be homogeneous within the group [86]. The group size should range from six to twelve individuals. The FGS are conducted by the moderator who follows a discussion guide while simultaneously

facilitates the debate, drawing attention to all questions and participants [87].

For a complete data collection a minimal of two FGS should be performed or as many as the required until no newer data is obtained. Assessment of complex topics may require until ten FGS [88]. Considerations regarding the physical space selection and organization are of great relevance in order to promote free and equitable participation within the individuals [89,92] .

Analysis of focus groups data it is basically the same that is applied to any other qualitative data. Rather than giving percentages to answers, qualitative analysis rely on conceptualization of the data content [93,94]. This process can be incredibly diverse and complex resulting in different methods [91].

Thematic analysis is seen as a foundational method for qualitative data analysis, as it provides core skills that will be useful for conducting many other forms of qualitative analysis. It consists in the identification of patterns (themes) within data and in the analysis of its meanings. Various techniques of identifying themes both manual and computerized, have been described [92].

Examples of other qualitative data analysis are content analysis and grounded theory. The first also “thematizes” data but explores the measurement of the frequency of different categories and themes, only if possible and with caution as a proxy for significance [93]. The second uses the “thematization” for inductively and systematically generate a theoretical explanation of the interest topic [90].

The analysis of focus group data has the advantage of exploring the interaction between research participants when compared with the analysis of qualitative data from other source.

Focus group can be used in combination with other methodologies within the same study either in the beginning as a

preliminary / exploratory phase or in the end in order to assess or complement a particular aspect of the study.

*

Another important recently developed approach is the **community-based participatory research** (CBPR). This partnership approach has by one side brought the community into the arena of social problems solving among with researchers, governmental or institutional personnel, by other side as a branch of research-action it actively participates in the change of a particular question in an organization whilst conducting research. Also mentioned as community-based research it equitably involves community members, organizational representatives and researchers in the full process of research, and distributes decision-making and responsibilities by all intervenient [94]. Other important principles of CBPR are: its basis on strengths and available resources within the community, its balance between the knowledge production and intervention for improve health outcomes, and its focus on public health problems with local relevance [95]. The CBPR approach is not strict but rather it should be discussed and adjusted according to intervenient, target-community and health-context. Therefore large and diverse examples of participatory/involved/collaborative research have been described in the literature [100-102]. The main benefits described as a result of involving the community through this approach have been a significant gain in knowledge, expertise and skills in the research process and an improvement of research quality, validity, sensitivity and practicability [98]. The recognition of the determinant role of an effective communication to cause behavioural changes, also led to the development of a new methodology – **Communication for Behavioural Impact** (COMBI). COMBI is methodology which incorporates the many lessons of the past 50 years regarding health education and communication in a behaviour-focused preventive strategy. This process intend to engage individuals in the adoption and the maintenance of recommended healthy behaviours in

different health contexts such as dengue, lymphatic filariasis, malaria or HIV [99].

Finally, **health promotion evaluation** is also well-accepted among health promotion experts to be a method of extreme relevance, mainly due to the emergent feature of this discipline. Extensive research explores approaches or models which select the methodologies that most achieve health promotion objectives and which enable them to continuously improve its applicability at the local level [58]. Research designs or methodologies for health promotion evaluation are not quite consensual. However, large literature have already explore different ways to perform it. Planning models such as the five phase Preced-Proced model may support the evaluation process [100]. Participatory evaluation is believed to be «a real catalyst for change» by some, but due to its profoundly challenging execution this evaluation approach is still often more consultive than participatory [58].

CONTRIBUTIONS TO DENGUE PREVENTION

The compliance to certain preventive, protective or therapeutic actions is frequently promoted in dengue-preventive campaigns. Due to the "domestic" feature of its main vector, and the lack of an effective vaccine or treatment, community participation is therefore crucial for prevention of dengue fever.

With the advent of health promotion dengue-professionals and researchers have detected some weaknesses in the strategies applied in past dengue prevention campaigns, as explored in following paragraphs.

The concept of community participation (derived from health promotion models) helped source reduction activities to be cost-effective and long-term sustainable. The community-empowerment ideology also helped community-based strategies to be more effective. In fact, the community-based educational campaigns which not only have transmitted to the community the key-information, but have also involved the public in the intervention process, were actually more successful in promoting

behaviour changes. Vertical actions (proposed and coordinated by governments in order to reach communities) were not able to ensure dengue-prevention alone, and therefore bottom-up or community-based interventions (in which community is involved since the beginning) were more and more encouraged [7,40].

However, with the development of behaviour models, KAPs were severally criticized in their scope. In fact, they commonly explore knowledge as a measure of practice, even if most of these studies rarely found a correlation between knowledge and practice [106-108]. Recent surveys which integrate the theoretical of behavioural impact models are therefore more focused on perceptions and beliefs of the community, rather than on its knowledge [103]. Consequently new terms (or disciplines) have emerged such as «lay epidemiology», «cultural epidemiology» and/or «epidemiology of beliefs» which look at how community beliefs are formulated [62,110,111]. All this have changed the scope of what is searched when collecting community views, improving the validity and the applicability of community surveys outcomes.

In what concerns community surveys analysis, despite the countless studies which suggest methodologies to accurately measure attitudes/beliefs/perceptions/feelings known in the literature, these are still timidly used.

Social marketing and communication theories recommend health promotion campaigns to use simple and pragmatic health-messages, contrasting with the common complex or vague behavioural proposals instance such for example: «eliminate or cover all containers on your property» [7]. Furthermore, there are many dengue-related proposed behaviours: some related to mosquito breeding prevention (preventive), some focused on personal protection against mosquito bites (protective), and others dedicated to disease management in order to achieve quick and effective recover (treatment-seeking). To be effective, campaigns should focus on one type behaviour and, if needed, change the type of behaviour focused according to the mosquito seasonality and/or outbreak dynamics [106]. Moreover, when promoting source-reduction practices, health-

messages should clearly explain the way to perform it and empathize the type(s) of breeding site to be eliminated. To achieve this purpose, a prior entomological characterization is advantageous in order to prioritize targeted breeding sites. All these communication lessons are strategically blended within the COMBI methodology. In dengue context COMBI methodology has been materialized into a comprehensive and innovative guide [106]. This guide presents a fifteen step-by-step process illustrated with real-life examples taken from twelve detailed case studies of current worldwide dengue programmes and it is intended for programme managers, NGOs, or researchers interested in integrating biological, chemical, environmental, and communication interventions in dengue prevention [112,113]. Some studies covering COMBI interventions have confirmed its efficacy in impacting behaviour [114,115] .

After all these contributions from health promotion, and despite the resultant knowledge gain regarding behavioural impact processes, effective communication and engagement, there are still few records of successful cases of community-based source reduction interventions. Fortunately, the academic and governmental interest have been enabling to evaluate them. The correspondent main lessons learnt reveal [7,114,116]. The difficulty to effectively encourage community participation after the 1970s could be attributed to the long experience of idealistic, infallible, turnkey solutions for mosquito-borne diseases such as DDT-spraying and YF vaccination. Moreover, since up to that period dengue prevention were of the exclusive responsibility of the governmental institutions, when community-based strategies started, its relevance was hardly understood by both official institutions and general public [7]. Furthermore, since health promotion is recent and its achievements are still being analysed, past decades of “bad” communication strategies may have demotivate public and professionals about its efficacy [111]. Moreover, due to its recent implementation, the majority of the current promising community-based and behavioural-focused interventions, still did not have time to produce visible outcomes [116,118]. Additionally, the time required for community engagement

strategies to be proposed, accepted, planned, implemented, evaluated and finally effectively control *A. aegypti* populations could also represent a motif of misjudging community-based interventions. Eventually less weight is given to the long period of time required in the development of the most frequently desired alternative tools.

Alternative tools for dengue prevention

After several decades of stagnation, research is now developing new classes of insecticides able to cause residual activity in the already resistant mosquito populations [119,120]. Nevertheless, attention should be given to the medical impact of mosquito chemical control [115]. Although, the known carcinogen effect of most of the available insecticides, these harmful chemicals are still legal for domestic and large-scale use due to the lack of healthier alternatives equally efficient [116]. Opposite to chemical control, biological vector control strategies have no associated medical impact for humans and moreover its resistance process is much slower. Vector control strategies based on the use of Cocepods, *Bacillus thuringiensis israelensis* (Bti) and *Wolbachia* are the most efficient ones, all of them with proven outcomes [123,124]. The first two are well-known larvicides which therefore should be applied in the breeding sites of mosquitoes. The latter is a bacteria which when infecting *A. aegypti* mosquitoes reduces its virus transmission and is vertically transmitted to the mosquito' progeny. Other promising biological larvicides are Spinosad a sub-product from *Saccharopolyspore spinosa* bacteria, and Piriproxyphen a growth inhibitor [125,126]. Mainly due to the monitoring required, this approach is still not widely considered as high-effective.

The use of other kind of genetically modified mosquitoes, such as the release of insects with a dominant lethal (RIDL) and the killer rescue-under dominance (KR-UD), are also very promising approaches to control mosquitoes [127,128]. By sterilising mosquito males or by conferring protection against virus infection they seem to have negligible or zero risk for humans, even though ethical issues for its usage are not entirely clarified.

The vaccine-based dengue prevention is still not a reality. There are six tetravalent vaccines in the pipeline, and one of them, the chimeric dengue/yellow fever vaccine has now entered phase 3 trials [15]. If proceeding all the phases of trials with success, they would be able to protect from the four dengue viruses serotypes known until 2013. However, the recent fifth new serotype pointed out further weakness of these vaccine candidates [22].

Finally, forward steps have been done in antiviral therapeutic research with intensified efforts to find specific dengue inhibitors and new tools which evaluate the efficacy of new drugs for rapid translation into trials in humans [129,130].

**

Overall, while waiting for the development of effective and innocuous solutions (vaccines, antivirals compounds, biologic insecticides or genetically modified mosquitoes), the best approach to prevent dengue is the adoption of an integrated vector management approach. The latter is defined by WHO as «a rational decision-making process to optimize the use of resources for vector control» [124]. This strategy is based on the certainty that no single approach will provide full success in *A. aegypti* control. Insecticide space-spraying is recommended for vector control in epidemics and should be used in combination with other interventions, such as source-reduction and biological control. This way, the efficacy, cost effectiveness, ecological soundness and sustainability of vector control interventions are perfectly optimized. In order to attain this integrated approach, «engage the community [...] as well as their participation in dengue prevention and control» is crucial and therefore, it constitutes one of the WHO's ten priorities until 2020 [124]. Contributions from studies which are able to put into practice the recent lessons regarding behaviour impact are urgent and extremely valuable.

AIMS

The **main goal** of this thesis is to explore ways to promote community engagement in preventive practices in order to strengthen Dengue prevention in Madeira Island, as a potential epidemic area and entry site for arboviroses into other temperate regions. Based on the surprising dengue outbreak event, further objectives were added, in order to take opportunity to explore the perceptions change due to the experience of dengue outbreak.

MAIN AIMS

In order to attain this goal, this thesis **aims** to assess community perceptions in *aegypti*-infested areas of Madeira Island (Portugal) through both quantitative and qualitative methods, in order to attain a full description of community perception (AIM I) and to explore how it is altered by a dengue outbreak experience (AIM II).

Accordingly with COMBI guidelines, a unique behaviour was selected, and thus only the community perceptions regarding it were assessed: the elimination/coverage/emptiness/washing of mosquito breeding sites in the domestic area (domestic source reduction or domestic *aegypti*-control) [106]. Perception regarding broad dengue preventive related issues was assessed in other to enrich the assessment of the perception regarding the main behaviour practice (domestic source reduction). These issues comprise questions not directly related to the main dengue preventive behaviour but which may also influence public perceptions regarding it. According to the World Health Organization, the terms 'community/public perceptions/views' used in the present work, mean «the collective views of a group of people (…)» involving understanding, misunderstanding and discernment [77].

SPECIFIC OBJECTIVES

Aims were divided in specific objectives which required the performance of some preparatory analysis, all of them listed bellow.

1. Assess community perception (Essential-Perception) regarding the domestic source reduction in the most *aegypti*-infested areas.
2. Describe most frequent type of domestic breeding sites present in households of individuals interviewed.
3. Explore associations between the Essential-Perception assessed and domestic presence of breeding sites (tool validation)
4. Identify determinant Essential-Perception personal-socio-demographic variables
5. Describe community perceptions regarding broad dengue-preventive issues.
6. Re-assess and compare Essential- Perception regarding the domestic source reduction in the most *aegypti*-infested areas, before and after the dengue outbreak
7. Explore associations between Essential-Perception scores of sample populations assessed before and after the dengue outbreak (model validation)
8. Confirm and complement assessment of community perception regarding the domestic source reduction using a qualitative research method

(PREPARATORY OBJECTIVES)

A. Island-wide entomological characterization and definition of *A. aegypti* most infested area

B. Development of a new tool for measuring perception regarding domestic source reduction (Essential-Perception analysis)

C. Development of a matching process model which assures homogeneity of six variables within two un-equal sized samples

STUDY DESIGN

Three studies were performed in order to accomplish the previously defined specific objectives.

(Prior-to-the-outbreak)

Study 1 - Epidemiological observational cross-sectional study
(Part 1 in SUB-CHAPTER II.1, accomplishing SPECIFIC OBJECTIVES 1-4)
(Part 2 in SUB-CHAPTER II.2, accomplishing SPECIFIC OBJECTIVES 5)
Using an inquiry by questionnaire survey for data collection and with two type different analysis: (i) through cumulative scale (Essential-Perception analysis) and focusing in perception regarding the domestic source reduction; (ii) through descriptive analysis and focusing broad dengue-preventive issues.

(Posterior-to-the-outbreak)

Study 2 - Epidemiological observational cross-sectional study
(in SUB-CHAPTERS III.1, accomplishing SPECIFIC OBJECTIVES 6 and 7)
Using an inquiry by questionnaire survey for data collection, and the same Essential-Perception analysis. Comparisons between before and after studies relied on a randomized blocked design, assuring homogeneity in relevant variables
Study 3 - Epidemiological qualitative study
(in SUB-CHAPTERS III.2, accomplishing SPECIFIC OBJECTIVES 8)
Using focus group sessions for data collection, and both deductive and inductive thematic analysis.

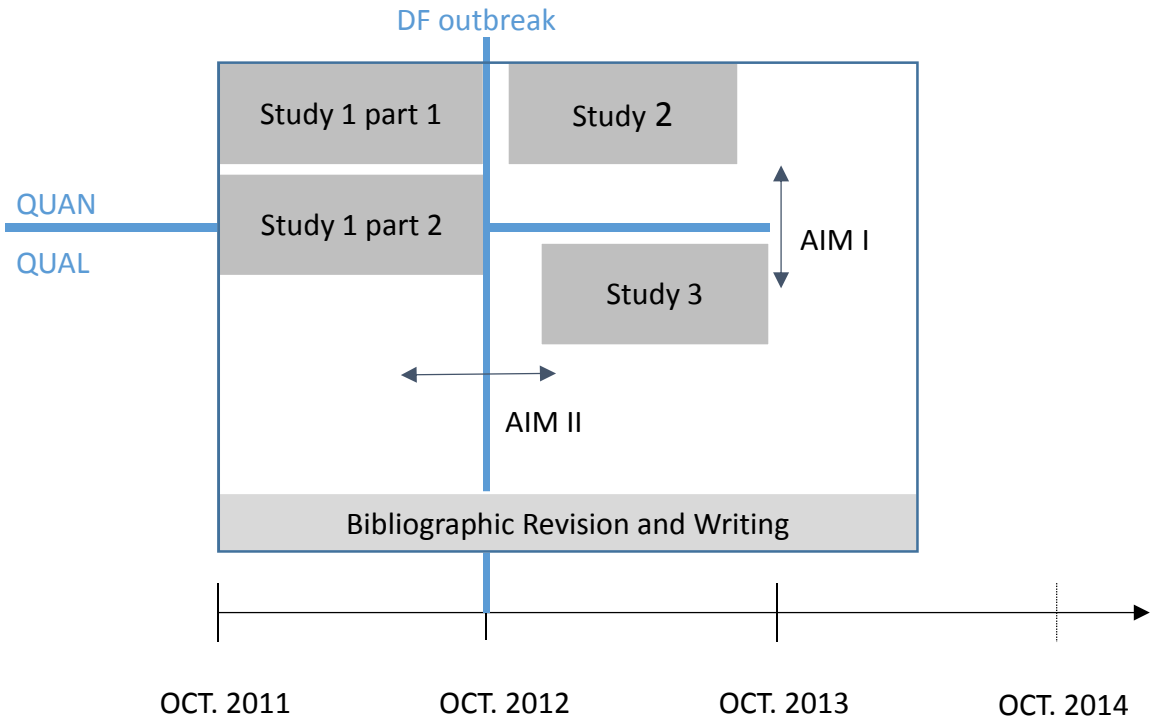
As a whole this thesis constitutes a sequential explanatory design. This type of study has a first phase of quantitative data collection and analysis which influences and provide information for a second phase of qualitative

data collection and analysis [125]. This classification assumes that the work performed before the outbreak was mainly quantitative.

As described in Figure I.7, there are two main axis which outlined this work: (i) the occurrence of a dengue fever (DF) outbreak in Madeira Island in 2012; and (ii) the use of multi-method research (quantitative and qualitative analysis). The latter axis have defined AIM I (attain a full description of community perception) which were reached by triangulation and complementarity typologies for quantitative-qualitative data combination. The former have defined AIM II (explore how perception is altered by a dengue outbreak experience) which were reached by a randomised block design for comparing two different sample populations.

FIGURE I.7 - PRESENT STUDY DESIGN

Scheme abbreviations: QUAN- quantitative data collection and analysis; QUAL - qualitative data collection and analysis; OCT- October



CHAPTER II: PRE-OUTBREAK WORK

This chapter presents the work performed before the outbreak. It comprises a unique questionnaire survey but is described in two separate sub-chapters. The first sub-chapter (II.1) covers the results concerning community perception regarding domestic source reduction, its correlation with presence of breeding sites and its personal-socio-demographic determinants, accomplishing specific objectives 1-4 (Study 1, Part1). The second sub-chapter (II.2) comprises results concerning community perception regarding broad dengue preventive issues completing objective 5 (Study 1, Part 2).

II.1 - «STRENGTHENING THE PERCEPTION-ASSESSMENT TOOLS FOR DENGUE PREVENTION: A CROSS-SECTIONAL SURVEY IN A TEMPERATE REGION (MADEIRA, PORTUGAL)»[4]

(STUDY 1, PART 1)

[4] This sub-chapter was published as Nazareth T, Teodósio R, Porto G, Gonçalves L, Seixas G, Silva AC, Sousa CA (2014) Strengthening the perception-assessment tools for dengue prevention: a cross-sectional survey in a temperate region (Madeira, Portugal). BMC Public Health 14: 39.

ABSTRACT

Community participation is mandatory in the prevention of Dengue outbreaks. Taking public views into account is crucial to guide more effective planning and quicker community participation in preventing campaigns. This study aims to assess community perceptions of Madeira population in order to explore their involvement in the *A. aegypti*'s control and reinforce health-educational planning. Due to the lack of accurate methodologies for measuring perception, a new tool to assess the community's perceptions was built. A cross-sectional survey was performed in the Island's *aegypti*-infested area, exploring residents' perceptions regarding most critical community behaviour: *aegypti*-source reduction and their domestic *aegypti*-breeding sites. A novel tool defining five essential topics which underlie the source reduction's awareness and accession was built, and is here called Essential-Perception (EP) analysis.

Of 1276 individuals, 1182 completed the questionnaire (92·6%). EP-Score analysis revealed that community's perceptions were scarce, inconsistent and possibly incorrect. Most of the population (99·6%) did not completely understood the five essential topics explored. An average of 54·2% of residents only partially understood each essential topic, revealing inconsistencies in their understanding. Each resident apparently believed in an average of four false assumptions/myths. Significant association ($p<0.001$) was found between both the EP-Score level and the domestic presence of breeding sites, supporting the validity of this EP-analysis. *Aedes aegypti's* breeding sites, consisting of décor/leisure containers, presented an atypical pattern of infestation comparing with dengue prone regions.

Essential-Perception seemed to be an accurate tool to assess community's perceptions regarding a specific behaviour. The studied population was not prepared for being fully engaged in dengue prevention. Moreover, incomplete knowledge may have generated the belief in false assumptions. Evidences suggest that EP-methodology was efficient and accurate in assessing the community perception and its compliance to practices.

BACKGROUND

Aedes aegypti is one of the most competent vectors of dengue, yellow fever and chikungunya viruses. Recent estimations suggest a global impact of 390 million dengue infections annually worldwide [21]. Since there are no vaccines or specific treatments for this arboviral infection, the reduction of vector density is one of the most straightforward strategies for its prevention. Furthermore, recent studies unravel the high cost-effectiveness of an active and continuous vector control as opposed to an answer to dengue outbreaks [126]. According to the World Health Organization (WHO), *A. aegypti's* control is mainly achieved by source reduction of the vector through the elimination of the mosquito breeding sites [127]. Due to *A. aegypti's* domestic ecological feature, their larvae preferably proliferate in small and artificial water-containers, placed inside or near human houses [128]. Therefore, community contribution is, undoubtedly crucial in dengue prevention and control [118,135] . Educational campaigns that inform and mobilize the local communities are often implemented in the infested areas. In most preventive campaigns, the community is asked to do *aegypti*-source reduction: to eliminate (cover, empty and/or remove) the most common domestic breeding sites. Abundant literature may be found reporting community-oriented educational interventions and assessments of community knowledge/attitudes/practices/perceptions/beliefs regarding dengue prevention, most of which are performed in tropical regions [58,59,136-141]. Even though the relevance of the latter issues is more and more recalled by important entities[142,143], most of the studies emphasize the need of new research approaches to explain and increase their commonly low efficacy [58,59,140,141,144,145]. Consequently, studies that suggest and/or test strategies that more effectively promote community behaviours and more accurately assess community perception, are of great need [77]. The 'community perception' term used here means «the collective views of a group of people (...) [perception] involves understanding/misunderstanding and discernment, and it includes a

choice and action (...) [perception is also] the product of social interaction», as stated by WHO [77].

In the past years, several viruses and vectors have significantly increased their geographic distribution as a result of globalization [43,146]. In 2005, *A. aegypti* specimens were recorded in Madeira, a temperate European island in the Atlantic, for the first time [34]. Rapidly, the local health authorities promoted educational activities based on television/radio communications, informative flyers/posters distribution and 'door-to-door' interventions to achieve community compliance in the domestic control of *A. aegypti*. In fact, despite these efforts, the mosquito population has thrived. Additionally, entomological studies reported high levels of resistance to DDT and pyrethroids in the local *A. aegypti* population [138].

In October 2012, less than one year after the beginning of this study, an outbreak of dengue was declared in the Island [139]. Currently, Madeira is at risk of becoming a dengue endemic territory. Also, being a highly touristic destination, it constitutes an open door for *A. aegypti* and/or dengue virus introduction into other temperate regions [140]. Moreover, non-tropic regions such as Europe and North America host *A. albopictus* another very competent arboviral vector [36,150,151]. A unique virus introduction into these temperate regions could trigger a disease epidemic [143]. Community-mobilization strategies that effectively reduce *A. aegypti's* densities in Madeira Island are thus, mandatory.

This study aims to estimate the community's perceptions of Madeira residents regarding source reduction, and identify the most frequent *aegypti*-breeding sites present in the domestic environment of this non-tropical region. An extensive and in-depth analysis is suggested as a novel tool for community perception assessment and educational planning.

METHODS

STUDIED POPULATION

The study area was chosen according to the *A. aegypti*'s distribution area, assessed by an island-wide entomological survey (Additional file II.1.1).

Based on mosquito abundance levels, a more restrictive zone called 'AEGYPTI', was selected. This area includes part of three municipalities[5]: Santa Luzia and São Pedro (both in Funchal county), and Câmara de Lobos (in a Funchal neighbouring county). A representative sample of residents aged 18 years old or over was selected from the electoral system database, using stratified sampling by the municipality. A universe of 13 433 adult subjects lived in the area of study (almost 7% of the Island's adult total population) [144]. A sample size of 1083 subjects, was required to fulfil the objectives of this study (90% confidence level and 2·5% precision). A prevalence of 50%, regarding good knowledge, was assumed. This sample size was inflated in 20% to account for non-respondents and incomplete interviews. Individuals who were not found or who refused to participate were replaced.

QUESTIONNAIRE AND ENTOMOLOGICAL INVENTORY

A cross-sectional survey was performed through face-to-face interviews. In each interview, both a questionnaire to assess the residents' perceptions and a domestic breeding site inventory of each household, were fulfilled. The surveys were performed by trained personnel (Health technicians of the local authority-IASAUDE) during October and November 2011. A total of three attempts were undertaken to contact the selected individuals: (i)-on weekdays between 9am and 5pm; (ii)-on weekdays between 5pm and 8pm; and (iii)-on Saturdays between 10am and 7pm. Participants gave oral informed consent prior to data collection. Previous to its application, the questionnaire was pre-tested in an *aegypti*-infested but non-selected area. The questionnaire comprised 13 questions, addressing five main topics (see criteria in Perceptions Evaluation paragraph): 'Medical Importance' (two questions), 'Local Context' (two questions), 'Domestic Attribute' (three questions), 'Mosquito Breeding' (three questions) and 'Control Measures' (three questions). The questionnaire also covered socio-demographic characteristics. The breeding site inventory listed 21 types of putative domestic breeding sites present in each household. The study

[5] This term is herein used in the sense of the term parish

was approved by *Instituto de Higiene e Medicina Tropical Ethics Committee,* Instituto de Higiene e Medicina Tropical, Universidade Nova de Lisboa, Lisbon (reference: 09-2013-TD).

PERCEPTION EVALUATION

In order to accomplish accurate and in-depth perception estimation, several analyses were made.

The most common answer frequency estimation several analysis were calculated (data not shown).

Then, a list of five essential topics regarding source reduction was defined. Topics correspond to variables known to determine behaviour changes, such as, self-efficacy, behavioural expectancies, perceived susceptibility, etc. as mentioned in several models of behavioural change described in the literature [145,154]. According to behavioural change experts, the list of variables/topics were chosen and adapted to dengue context and to the particular Madeira scenario [145,154]. The five selected variables (here called 'topics') are individually labelled as: (*A. aegypti*'s) Medical Importance, (its) Local Context, Domestic Attribute (of its vector-control), Mosquito Breeding (process) and finally, (vector)-Control Measures. We established the awareness and the understanding of these five topics as necessary and obligatory for the acceptance and presumed consequent adherence to (and consequent adherence) to domestic source reduction practice.

Two concepts were selected to evaluate each of the latter five topics (these are here called 'essential concepts'). By evaluating the acknowledgement of both concepts, a double-evaluation of the understanding of each of the five topics was done. This allowed for the detection of discrepancies in the way these five topics are understood. Collectively the ten concepts sum-up the awareness of the source reduction. This way, this methodology allows the estimation of the community's perceptions through three distinct approaches: (i)-score of Essential-Perceptions, (ii)-topic understanding and (iii)-discrepancy detection/myth estimation, all described below.

Concepts assimilation and score of essential-perceptions (EP-Score)

According to the residents' answers, the acknowledgement of the ten essential concepts was calculated. Each concept corresponds to one or two questions. We obtained the EP-score for each resident assimilated (from 0 to 10), by attributing one point to each perceived essential concept. Thus, EP-score level corresponds to the number of (essential) concepts, out of the ten established that each resident has assimilated. Following EP-analysis' criteria, only those who achieved an EP-score equal to 10 showed minimal and adequate perceptions to trigger individual compliance in source reduction (see an example in Additional file II.1.2). Respondents who have not answered all the thirteen questions were excluded from score calculation.

Topic understanding

The understanding of the five covered topics was evaluated according to the knowledge shown in topic-related essential concepts (Figure II.1.1 and II.1.2). Only residents who have acknowledged both topic-related concepts had completely understood the topic. The acknowledgement of only one out of the two topic-related concepts revealed a partial understanding. Residents who did not perceive any of the two topic-related concepts did not understand the topic.

False perceptions/myths estimation

Partial or absent understanding of one of the five topics could generate false perceptions concerning it (Additional file II.1.3). By analysing the acknowledgement of concepts for each topic and the discrepancies in its understanding, a list of myths (false information that is perceived as true by a part of the population) was estimated and also its supposed frequency in the population (Additional file II.1.4).

STATISTICAL ANALYSIS (TEST STATISTICS)

All collected information was introduced and records were double-checked. Statistical analysis was performed using Excel (Microsoft Office, Windows Vista) and Statistical Package for Social Sciences 19.0 (SPSS, Inc., Chicago,

IL, USA). Answers obtained from the questionnaire were re-coded to obtain other categorical variables linked to the above mentioned ten concepts. Determinants of the EP-Score level and predictors of the domestic presence of breeding-sites were also explored. EP-Score percentiles for each socio-demographic group were calculated following Weighted Average method (Table II.1.1 and II.1.4). Comparisons of score medians between socio-demographic groups were made using non parametric tests: Mann-Whitney and Kruskal-Wallis (Table II.1.1, II.1.3 and II.1.4). Associations/differences with the domestic presence of breeding sites were performed using three different approaches: (i)-individual essential concepts: assessed by a chi-square test for categorical variables (Table II.1.3); (ii)-EP-Score: assessed by Weighted Averaged method and Mann-Whitney test (Table II.1.3); (iii)-Incomplete Scores (four combinations of scores covering four out of the five main topics) also assessed by Weighted Averaged method and Mann-Whitney test (Table II.1.5). In this latter point (iii), by filtering the residents that showed zero points regarding each of the five topics separately, four combinations of incomplete EP-Scores (from 0 to 8 points) were generated. Additionally, logistic regression models were also performed to explore socio-demographic factors that contribute to achieve, or not, an EP-Score equal to or higher than seven. The cut-off would preferably be an EP-Score equal to ten (instead of seven). However, due to the inexistence of a minimum number of individuals that have reached the maximum (EP = 10), the cut-off was adjusted until seven in order to include an enough number of individuals needed to perform the logistic regression.

RESULTS

A total of 1276 AEGYPTI-residents participated in the study. Out of these, only 92·6% (1182 individuals) answered the thirteen questions and were scored according to the perceptions demonstrated. All individual residences were inventoried to putative breeding sites. Table II.1.1 shows the socio-demographic characteristics of the studied population.

TABLE II.1.1 - SOCIO-DEMOGRAPHIC CHARACTERIZATION OF THE INQUIRED / SCORED OPULATION AND EP-SCORE RESULTS PER SOCIO-DEMOGRAPHIC GROUPS.

Some descriptive statistics (percentages, median, and percentiles) illustrate the socio-demographic feature and EP-score results. Comparisons of EP-score's medians between socio-demographic groups are also presented (p-values). Not all the respondents answered all the socio-demographic questions, thus correspondent n values are described.

	Inquired population (n=1276)	Scored population (n=1182)		
	n	n (%)	EP-score median (P_{25}-P_{75}) [+]	*p*-value
Gender (n=1267)				<0·001 '
Male	506	480 (40·6)	5·0 (4·0 - 7·0)	
Female	761	701 (59·4)	5·0 (3·0 - 6·0)	
Education level (years) (n=1251)				<0·001 ''
Never studied (0)	75	69 (5·9)	3·0 (2·0 – 4·0)	
Fourth Grade (4)	484	446 (38·2)	4·0 (3·0 – 5·0)	
Ninth Grade (9)	281	262 (22·5)	5·0 (4·0 – 6·0)	
High School (12)	220	207 (17·7)	6·0 (4·0 – 7·0)	
Upper Education (+12)	191	183 (15·7)	7·0 (6·0 – 8·0)	
Age groups (years) (n=1256)				<0·001 ''
25 or younger	170	154 (13·2)	4·0 (3·0 – 6·0)	
26-35	172	161 (13·8)	5·0 (3·0 – 7·0)	
36-45	197	191 (16·3)	5·0 (4·0 – 7·0)	
46-55	221	207 (17·7)	5·0 (4·0 – 7·0)	
56-65	182	174 (14·9)	5·0 (3·0 – 6·0)	
66-75	185	167 (14·3)	5·0 (3·0 – 6·0)	
76 or older	129	116 (9·9)	4·0 (3·0 – 6·0)	
Municipality (n=1275)				<0·001 ''
Santa Luzia	417	388 (32·9)	6·0 (4·0 – 7·0)	
São Pedro	314	304 (25·7)	5·0 (4·0 –7·0)	
Câmara de Lobos	544	489 (41·4)	4·0 (3·0 – 5·0)	
Travelled to DEC (n=1245)				<0·001 '
yes	311	287 (24·7)	5 ·0 (4·0 – 7·0)	
no	934	876 (75·3)	5·0 (3·0 – 6·0)	
'Bitten by mosquitoes'[6] (n=1271)				<0·001 '
yes	944	887 (75·2)	5·0 (4·0 – 7·0)	
no	327	293 (24·8)	4·0 (3·0 – 6·0)	

[+] Weighted Average method; ' Mann-Whitney test ; '' Kruskal-Wallis test

[6] also mentioned as AME (admitted mosquito exposure)

EP-ANALYSIS

EP-score and concepts assimilation

Respondents' EP-score distribution is represented in Figure II.1.1. Only 0·4% out of the scored respondents (five individuals) achieved an EP-score=10. The total population recognized an average of five essential concepts, half of those evaluated.

Population acknowledged the ten essential concepts differently (Figure II.1.2). The concepts 'Medical Importance 1' and 'Control Measures 1' were the most well-acknowledged ; 86·3% of the interviewed admitted that mosquitoes can transmit diseases (MI1-concept) and 77·2% referred to the reduction of breeding sites as being a «(fairly/very/extremely) effective measure» in controlling mosquitoes (CM1-concept). On the contrary, concepts 'Control Measures 2' and 'Domestic Attribute 1' were the least recognized; only 26·4% acknowledged that "mosquitoes can breed inside houses" (DA1-concept) whereas only 20·3% of the studied population correctly admitted to CM2-concept which did not identifying the use of a flyswatter or indoor insecticide spraying, as effective for *aegypti*-control.

FIGURE II.1.1– PROPORTION OF RESPONDENTS THAT ACHIEVED EACH EP-SCORE'S LEVELS (in percentage, n Total=1182)

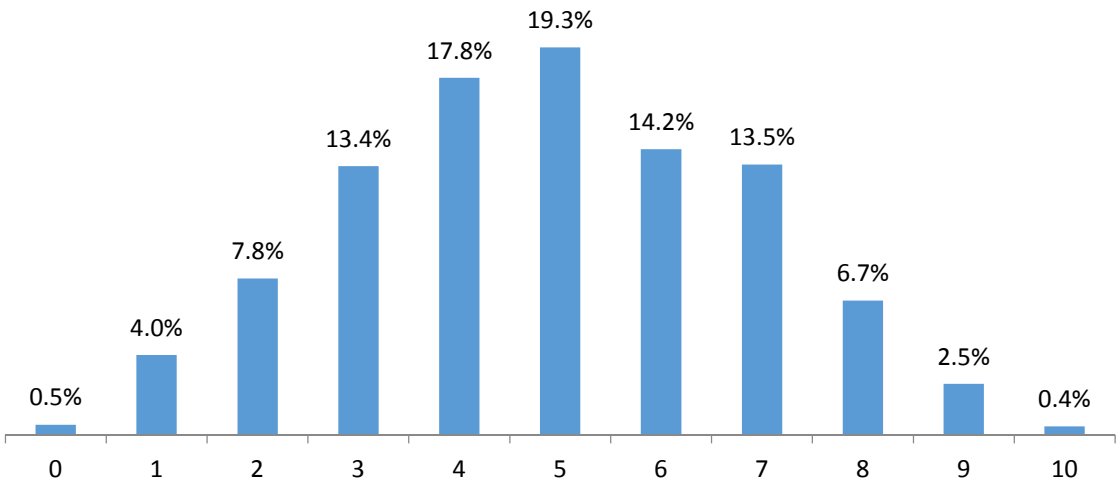
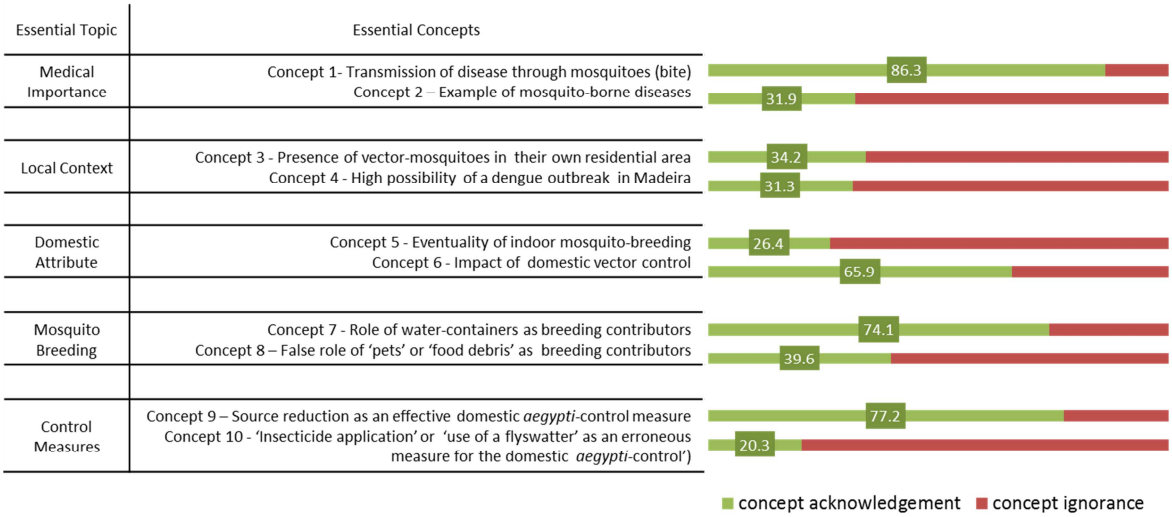


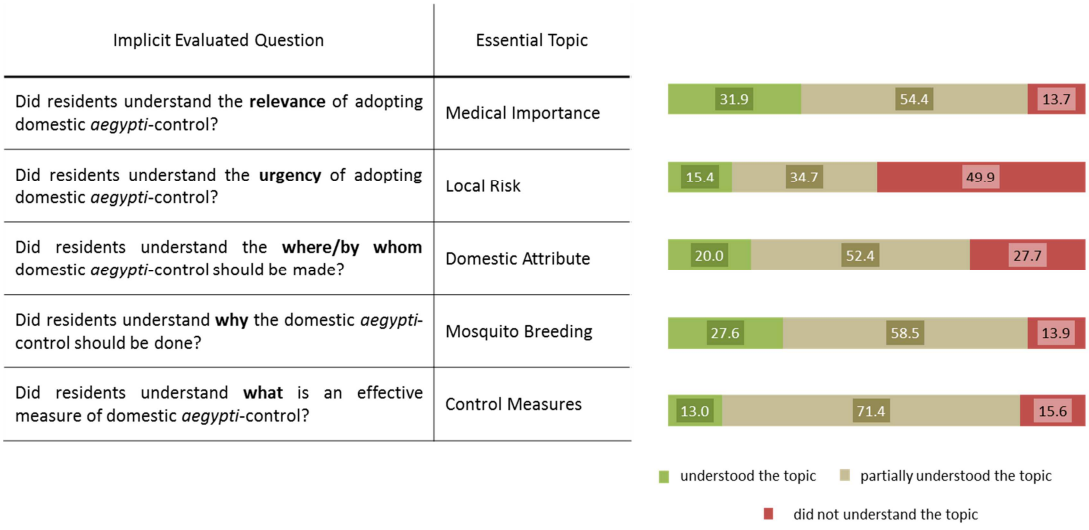
FIGURE II.1.2 – PROPORTION OF RESPONDENTS THAT ACKNOWLEDGED EACH ESSENTIAL CONCEPT



Topic understanding

Regarding the topics, shown in Figure II.1.3, 'Medical importance' was the one that more people have completely understood (31·9% of the studied population), while both the concepts related to 'Control Measures' were only recognized by 13·0% of the respondents. By analysing each topic separately, Figure II.1.3 reveals that the majority of the respondents presented partial understanding of four out of the five topics. Differently, for 'Local Context' the highest proportion of the respondents disregarded both topic-related concepts.

FIGURE II.1.3 – PROPORTION OF RESPONDENTS THAT 'UNDERSTOOD', 'PARTIALLY UNDERSTOOD' AND 'DID NOT UNDERSTAND' EACH ESSENTIAL TOPIC



False perceptions/myths estimation

Based on the analysis of AEGYPTI-residents topics understanding a list of thirteen alleged myths was elaborated and its supposed frequency in the population calculated (Additional file II.1.4). The most disseminated myth was: «the insecticide usage as an effective measure to control *aegypti*-mosquitoes» found in 79·7% of the scored population. Each resident believed, on average, in four out of the thirteen myths. Most of them (99·5%) believed at least in one myth (Table II.1.2).

TABLE II.1.2 – LIST OF ALLEGED MYTHS AND FREQUENCY OF RESIDENTS THAT BELIEVED IN EACH OF THEM

Based on the analysis of the discrepant knowledge showed concerning topic-related concepts, false assumptions/myths were inferred to be present in the scored population (see Myths' estimation on Addition Files).

Essential Topic	Alleged Myth		n (%)
Medical Importance	Myth 1	'Mosquitoes do not transmit diseases'	162 (13·7)
	Myth 2	'Mosquitoes only cause mild clinical consequences such as allergies, fever, etc.'	643 (54·4)
Local Risk	Myth 3 and Myth 4	'Dengue is not a mosquito-borne disease' and/or 'Dengue only occur in tropical/non-developed countries"	222 (18·8)
	Myth 5 and Myth 6	'Since I do not feel the byte, I am not at risk of being bitten/infected' and/or 'Mosquitoes are allocated in a specific area and are not able to spread through the island'	188 (15·9)
	Myth 7	'Madeira's residents are not at risk'	590 (49·9)
Domestic Attribute	Myth 8	'Local health authorities are the key intervenient in the control of mosquitoes'	76 (6·4)
	Myth 9	'Insecticides or other protective measures can control mosquitoes'	543 (45·9)
	Myth 10	'I am (Community is) not an intervenient in the *aegypti*-control'	327 (27·7)
Mosquito Breeding	Myth 11 and Myth 12	'Clean houses or houses without pets/animals do not have mosquitoes' and/or 'Clean people have nothing to do concerning the control of mosquitoes'	714 (60·4)
Control Measures	Myth 13	'By the usage of insecticides and/or flyswatter, I am already contributing to the *aegypti*-control'	942 (79·7)

Average of believed myths per scored resident : four out of the thirteen myths

Proportion of scored residents that believed in at least one alleged myth: 99·5 %

ENTOMOLOGICAL DESCRIPTION, ITS DETERMINANTS AND ASSOCIATIONS WITH PERCEPTIONS

Out of all the 1276 interviewed individuals 79·6% lived in houses with at least one putative breeding site. The most frequent breeding sites were: flower-pot dishes, present in 52·7% of the respondent's houses; out-door sinks (35·7%); water-accumulation on decks (23·3%); flower vases (21·7%) and pet water-dishes (18·8%) (Additional file II.1.5).

Statistical tests were performed in order to explore whether or not the presence of breeding sites were determined by the EP-Score level. According to Table II.1.3, no significant differences were found between those that admitted/not admitted to concepts 'Mosquito Breeding1' and 'Control Measures1'. However, residents who had breeding sites in their households had significantly lower EP-scores compared to those living in houses without breeding sites.

TABLE II.1.3 – ASSOCIATIONS BETWEEN THE DOMESTIC PRESENCE OF PUTATIVE BREEDING SITES (ANY TYPE)
(a) acknowledgement of concept 'Mosquito Breeding1'; (b) concept 'Control Measure1' and (c) cumulative essential-concepts' acknowledgement: EP-score.

		Residents living in houses…				
		…WITH breeding-sites		**….WITHOUT** breeding-sites		
		n (%)	**median (P_{25}-P_{75})$^{+}$**	**n (%)**	**median (P_{25}-P_{75})$^{+}$**	***p*-value**
(a) "Role of water-containers as breeding inducers[7] (Concept 7)"	acknowledged	699 (73·4)	-	177 (77·0)	-	0·272 ˇ
	did not acknowledge	253 (26·6)	-	53 (23·0)	-	
(b) "Source reduction as an effective domestic *aegypti*-control measure (Concept 9)"	acknowledged	728 (76·5)	-	184 (80·0)	-	0·253 ˇ
	did not acknowledge	224 (23·5)	-	46 (20·0)	-	
(c) EP-score		952 (80·5)	5·0 (3·0 – 6·0)	230 (19·5)	5·0 (4·0 – 7·0)	0·001'

' Mann-Whitney test ; ˇPearson test; $^{+}$ Weighted Average method

Comparing the five 'Incomplete Scores' within both of the residents' houses with/without domestic breeding sites, none of the five combinations varied significantly (see Table II.1.4). Municipality also presented significant association with the presence of domestic breeding sites, being 'Santa Luzia' the one with higher frequency of households without breeding sites (Additional file II.1.6).

[7] situations or occurrences that will promote mosquito development

TABLE II.1.4 – ASSOCIATION OF EP-INCOMPLETE SCORES AND PRESENCE OF DOMESTIC BREEDING SITES
Incomplete EP-score covered only four out of the five Essential Topics.

Essential Topic excluded	Residents living in houses **WITH** breeding-sites n ; median (P_{25}-P_{75})$^{+}$	Residents living in houses **WITHOUT** breeding-sites n ; median (P_{25}-P_{75})$^{+}$	***p* - value** ‘
Medical Importance	137 ; 2·0 (2·0 – 4·0)	25 ; 3·0 (1·0 – 4·0)	0.615
Local Risk	484 ; 4·0 (3·0 – 5·0)	106 ; 4·0 (3·0 – 5·0)	0.399
Domestic Attribute	267 ; 3·0 (2·0 – 4·0)	60 ; 3·0 (2·0 – 4·0)	0.515
Mosquito Breeding	138 ; 3·0 (2·0 – 4·0)	26 ; 3·0 (1·0 – 3·0)	0.367
Control Measures	155 ; 3·0 (2·0 – 3·0)	29 ; 2·0 (1·0 – 3·0)	0.351

‘Mann-Whitney test; $^{+}$ Weighted Average method

SOCIO-DEMOGRAPHIC CHARACTERISTICS AND PERCEPTION DETERMINANTS

All analysed socio-demographic characteristics presented significant differences in EP-scores medians (Table II.1.1). Actually, all males, residents aged 26-35 years old, people that had twelve years or more of education, individuals that live in ‘Santa Luzia’, respondents that have travelled to DEC and those that admitted to have been bitten by mosquitoes, have embraced more essential concepts than their correspondent socio-demographic groups. Following the logistic regression, four socio-demographic characteristics significantly determined a minimum of seven acknowledged essential concepts (EP-Score equal to or higher than seven). These were residents’ ‘gender’, ‘municipality’, the eventuality of being ‘bitten by mosquitoes’ and above all ‘educational level’ (Additional file II.1.7).

DISCUSSION

Comparing to other studies, analysis of single concept frequency[8] revealed an (apparent) very good community knowledge [140,141] . For example, almost 80% of the population recognized that «the source reduction is an effective measure for domestic *aegypti*-control» (Control Measure 1). However, perception evaluation based on EP-score showed that several essential concepts are still unknown by the majority of the population. Regarding topics understanding, only a few respondents completely understood each of the five topics. In all of them, a great discrepancy was found within the knowledge shown in concepts covering the same topic, predicting the presence of alleged myths/erroneous perceptions in most of the AEGYPTI-population. As suggested in Additional file II.1.3, the dissemination of part of the information can promote the advent of myths. To notice, through an anthropological view these myths are considered the real perception of the community [146]. They are here called 'erroneous perceptions or myths' since they oppose and contradict what, to date, is considered to be the main community vector-control practice. Sequential educational activities should take into account those myths given that they could be much harder to amend than the lack of awareness itself.

Four socio-demographic determinants were described in the logistic regression results. Similarly to other studies, the education level was the most relevant determinant in the EP-Score level above 7, emphasizing the relevance of extensive health education programs to improve the health-literacy levels [34-37][156-159]. The 'bitten by mosquitoes' variable[9] (stating the recognition of having been bitten by mosquitoes) also showed to be a determinant in the level of EP-Score. These suggests that measures that make the problem more 'visible' would be of a great impact in community awareness, especially for those who lack the allergic reaction to the bite. Determinants such as, 'Gender', and 'Municipality' should be considered in the selection of target groups/areas for further campaigns.

[8] descriptive analysis

[9] also mentioned as AME, reflects those who admitted/not to had been bitten by mosquitoes

Concerning the entomological survey, only putative breeding sites were inventoried. Due to the un-expected absence of rainfall during the period of the study (carried-out during the beginning of the rainy season), most of the containers were dry (Additional file II.1.8). Nevertheless, this was, to our knowledge, the sole entomological survey in a temperate region describing the most common *A. aegypti*'s domestic breeding sites. The most inventoried putative breeding sites were housing-components present in any patio, balcony or garden areas. An *aegypti*-infestation pattern was observed compatible with a clean, organized and well maintained urban environment (as schematized in Additional File II.1.9). These results contrast with the common symbols of mosquito infestation in dengue endemic regions, often related to water supply and waste disposal (tires, water tanks, etc.) [160,161,162]. 'Santa Luzia's municipality showed a significantly higher percentage of houses without breeding sites compared to the other two municipalities. This could be explained by a higher conscience of the *A. aegypti*'s presence in 'Santa Luzia' since it was where this mosquito first appeared.

Associations found between EP-Score and presence of domestic breeding sites supported the established criteria (Table II.1.3 and II.1.4). The important and most acknowledged concepts: DA2 and CM1, *per se* did not correlate with the absence of breeding site removal. Yet, the EP-score level is significantly higher in respondents living in households without putative breeding sites (Table II.1.1). These results seem to support that essential-concepts' cumulative assimilation is needed for triggering the adoption of the aimed behaviour. Moreover, results from the Incomplete Scores revealed that none of the five topics were dispensable in the improvement of the source reduction compliance. Evidence was provided to use the EP-Score analysis as an accurate tool for perception estimation. Furthermore, comparing to the alternative simple analysis of frequencies (see Table II.1.3), this tool provides deeper and more precise results to explore the community involvement. Actually, the major limitation of knowledge/perception assessments is the lack of its correlation with the adoption of proposed practices, frequently observed in similar studies

(most commonly, knowledge-attitudes-and-practices surveys) [59,112,139,143,156-158]. Methodologies that estimate awareness based on a score were already used in other surveys [59,141]. However, these approaches rarely or never focus on a specific behaviour, and almost never test understanding discrepancies. Since the adoption of different dengue-related practices (preventing, protecting, diagnosing, treatment-seeking practices, etc.) implicates the understanding of distinct concepts, behaviour-oriented approaches are much more useful to prioritize health-messages and plan campaigns [106]. Analysis of discrepancies in the understanding has been suggested as a way to improve reliability in KAP surveys. Similar studies are now needed to confirm whether this approach is indeed more accurate to assess perceptions and more effective to promote behaviours in the community.

CONCLUSIONS AND FUTURE IMPLICATIONS

After seven years of coexistence with the *A. aegypti,* Madeira Island presents an atypical scenario of domestic infestation. Subsequent to several local educational activities, AEGYPTI-community perceptions regarding source reduction were not only insufficient, but also, inconsistent and possibly incorrect. Therefore, future educational activities addressing the essential concepts and the alleged myths may help the community in fully engaging in the proposed behaviour. However, after the experience of a dengue outbreak (2012), local population has probably altered their perception, namely in what concerns the topic 'Local Context'. Moreover, since, no haemorrhagic clinical cases were detected in the latter outbreak, the real 'Medical Importance' of dengue could be still underestimated. These ideas should also be considered by those planning further educational activities on the island. As part of future actions the implementation of another questionnaire, similar to the one carried-out in this study, should be encouraged. In reality, with its recent dengue event, Madeira Island presents an exceptional opportunity to understand the effect of a disease-outbreak in a community's awareness. Finally, findings

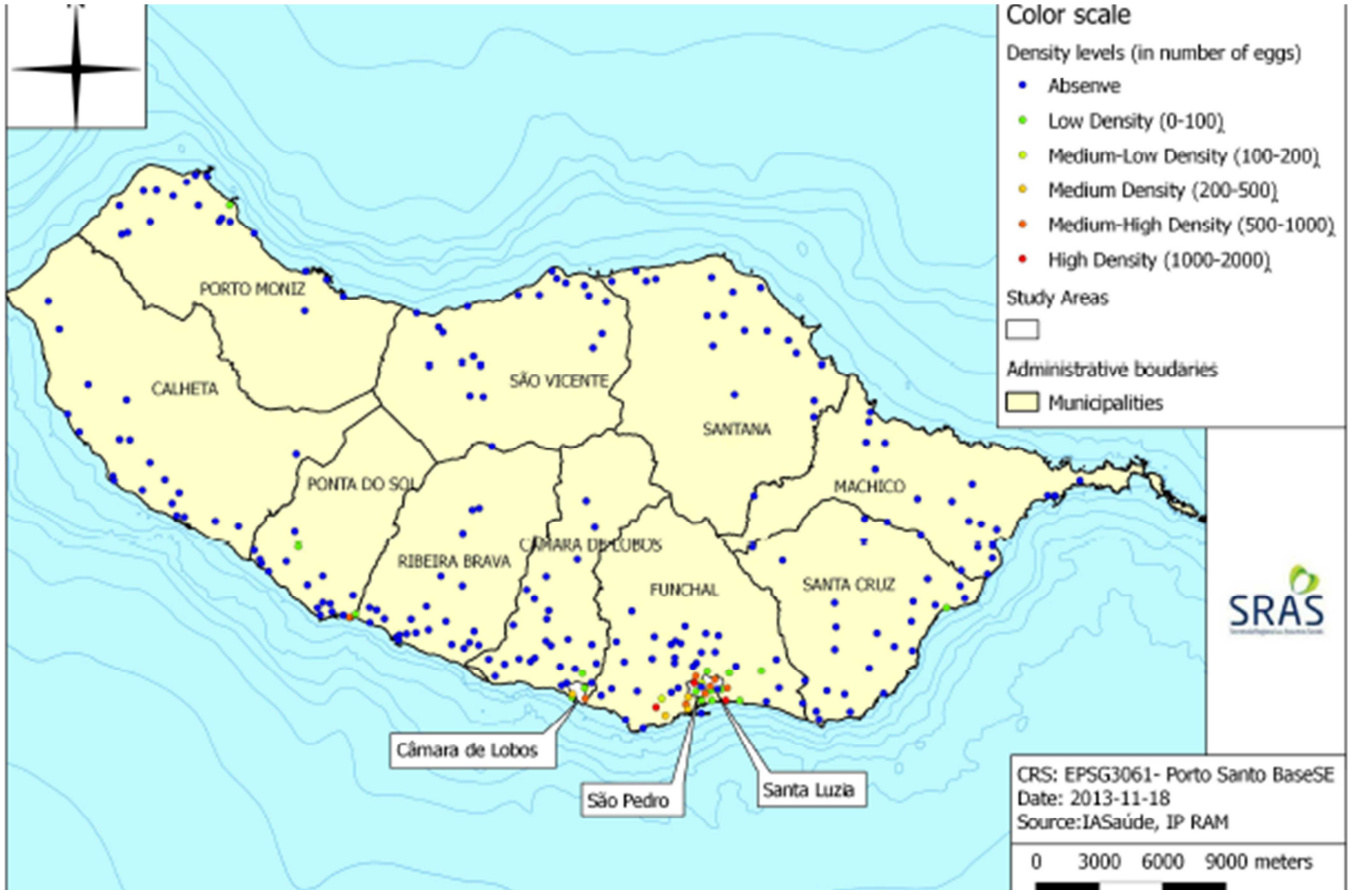
of this study support the use of EP-Score methodology as a more efficient tool to evaluate the community-perception regarding a specific behaviour. When further tested, this type of tool will probably prove to be of great value for other health problems, far beyond dengue prevention.

ACKNOWLEDGEMENTS

We thank to Fundação para a Ciência e Tecnologia (FCT) for funding this work (references:PTDC/SAL-EPI/115853/2009 and SFRH/BD/51012/2010), all the survey respondents who participated in the study, and the survey staff who did the interviews.

ADDITIONAL DATA

Additional file II.1.1– A. aegypti's distribution area (2001). Ovitrap distributions in the two inhabited island of Madeira's archipelago: Madeira and Porto Santo (2011). Red Points correspond to positive ovitraps, Green Points correspond to negatives ones.
Administrative boundaries described as «Municiplities» refer to what in the text is considered «county» or «Municipal Division»



Additional file II.1.2 – Relevance of cumulative knowledge: Exploring why a 'higher' level of knowledge doesn't necessarily reflect a 'better' awareness

Let's explore the awareness of two hypothetic cases, respondent number 209 and number 344. Number 209 knew that mosquitoes could transmit disease and gave "Dengue" as an example, showing that he/she had a complete notion of the Medical Importance of Mosquitoes; he/she also knew that those mosquitoes are in Santa Luzia (his/her area of residence), and recognized the possibility of a dengue outbreak in Madeira. He/she had only understood two of the five themes assessed (this knowledge corresponds to a Score of EP = 4). Case number 344, had the maximum score for four of the five analysed themes, he/she admitted more concepts than number 209. He/She simply did not admit that mosquitoes could breed inside houses (this knowledge corresponds to a Score of EP=9). Number 344 probably won't adhere to the domestic control since he/she didn't understand the real need of control his/her domestic area. Even though case number 344 has more essential perceptions than case number 209, none of them have the sufficient amount of knowledge to be aware of their own involvement in domestic vector control.

Additional file II.1.3 – Myth's appearance: Explaining an example of how a myth can appear from a partial (non-cumulative) understanding

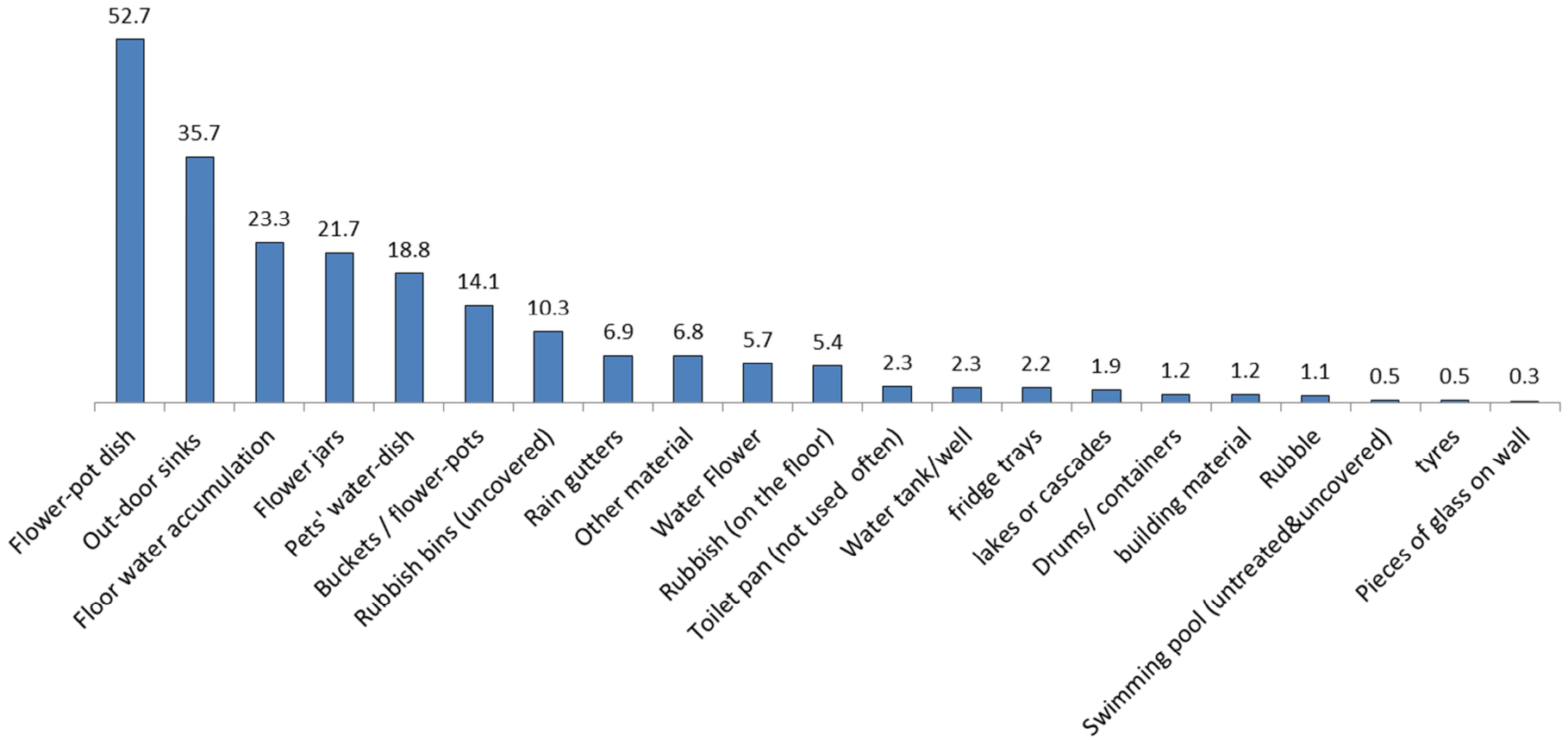
For instance, let's explore the meaning of (correctly) admitting that water accumulation leads to the breeding of mosquitoes, but also (erroneously) believe that "food debris can contribute to mosquito breeding". Food debris on its own (without water accumulation) does not serve as a larvae habitat. Without the mentioning of water accumulation, this belief supports the erroneous idea that "clean places aren't infested by mosquitoes". As a result, people who assume their own houses as being "clean" may not feel implicated in domestic *aegypti*-control.

Additional file II.1.4 – False perceptions/myths estimation through the analysis of residents' topic understanding

Concepts acknowledgement comparison		Analysis of Topic's Understanding	Community Understanding / Alleged myths
Concept 1	**Concept 2**	**Medical Importance**	
✓	✓	31·9 % (377 ind.) Residents admitted that mosquitoes transmit diseases such as 'Dengue' (22·5%), 'Malaria' (9·5%), 'Yellow fever' (3·1%) or other mosquito-borne diseases (1·2%) or few of the latters.	Residents seemed to understand the real medical importance of mosquitoes and, thus the relevance of being involved in the *aegypti*-control.
✓	X	54·4 % (643 ind.) Even though admitting that mosquitoes can transmit diseases, these residents did not know what kind of diseases mosquitoes transmit. Some residents erroneously referred 'allergies' as mosquito-transmitted diseases (6.3%) and 4·5% mentioned other false clinical consequences such us 'SIDA', 'fever' or 'cancer'.	These residents were not aware of the relevance of being involved in the *aegypti*-control. Alleged Myth 2: "Mosquitoes only cause mild clinical consequences such as allergies, fever, etc."
X	✓	Not observed	
X	X	13·7% (162 ind.) Residents did not know that mosquitoes can transmit diseases	Residents did not understand the medical importance of mosquitoes. Alleged Myth 1: "Mosquitoes do not transmit diseases"
Concept 3	**Concept 4**	**%**	**Local Risk**
✓	✓	15·4% (182 ind.) Residents recognized that there were mosquitoes that transmit diseases in their residential area, and, also, that there was a risk of a dengue outbreak in Madeira.	Residents seemed to understand the local context they are submitted and, thus the urgency of being involved in the *aegypti*-control.
✓	X	18·8 % (222 ind.) Residents recognized presence of mosquitoes that transmit diseases in their residential area; however they believed that a dengue outbreak will not emerge in the island. Allegedly some made this confusion because they did not recognize dengue as a mosquito-borne disease (20·3%). Eventually some residents could think that Madeira is "protected" since those kind of severe epidemic diseases historically never occurred in temperate countries.	These residents were not aware of the urgency of being involved in the *aegypti*-control. Alleged myths 3 and 4: (i) – "Dengue is not a mosquito-borne disease"; (ii) - "Dengue only occurs in tropical/non-developed countries".
X	✓	15·9 % (188 ind.) Residents did not recognize the presence of mosquitoes, in their residential area, that can transmit diseases; but admitted that a dengue outbreak can emerge in the island. These residents did not have a correct notion of the *aegypti's* distribution area. Since 22·2% out of these group referred not be 'bitten by mosquitoes', they could believe that they are at lower risk of being infected in an eventual outbreak.	Residents did not understand the risk they are subjected to and neither the urgency of being involved in the *aegypti*-control. Alleged myths 5 and 6: (i) -"Mosquitoes are allocated in a specific area and are not able to spread through the island"; (ii) - "Since I do not feel the byte, I am not a risk of being bitten/infected".
X	X	49·9 % (590 ind.) Residents did not recognize mosquitoes that transmit diseases in their residential area neither the possibility of a dengue outbreak in the island.	Residents did not understand the risk they are subjected to neither the urgency of being involved in the *aegypti*-control. Alleged Myth 7 : "Madeira's residents are not at risk"
Concept 7	**Concept 8**	**%**	**Domestic Attribute**
✓	✓	20·0 % (236 ind.) Residents know that mosquitoes can breed inside houses and recognized that domestic *aegypti*-control do have impact in the reduction of *aegypti*-population.	Residents seemed to understand the domestic attribute of the *aegypti*-control and, thus why community is the key intervenient in the *aegypti*-control.
✓	X	6·4% (76 ind.) Residents know that mosquitoes can breed inside houses but they did not believe that the domestic *aegypti*-control have impact in the reduction of the *aegypti*'s population. They probably believed that other intervenients have much more impact in the reduction of the *aegypti*'s population.	Residents did not understand the domestic attribute of the *aegypti*-control, neither why community is the key intervenient in the *aegypti*-control. Alleged Myth 8: "Local health authorities are the key intervenient in the control of mosquitoes".

X	✓	45·9 **%** (543 ind.)	Mosquitoes cannot breed inside houses but domestic *aegypti*-control does have impact in the reduction of *aegypti*-population in the neighborhood. Those respondents believed in their role in domestic *aegypti*-control but did not understood why that control has an impact.	Residents did not understand the domestic attribute of the *aegypti*-control, neither why community is the key intervenient in the *aegypti*-control. Alleged Myth 9: "Other protective measures can control mosquitoes".
X	X	27·7**%** (327 ind.)	Residents do not know that mosquitoes transmit disease, neither that their involvement have an impact in the control of mosquitoes.	Residents did not understand the domestic attribute of the *aegypti*-control, neither why community is the key intervenient in the *aegypti*-control. Alleged Myth 10: "I am (Community is) not an intervenient in the *aegypti*-control".
Concept 5	**Concept 6**	**%**	**Mosquito Breeding**	
✓	✓	27·6**%** (326 ind.)	Residents only identified water-containers (and not other false issues) as mosquitoes' breeding inducers.	Residents seemed to understand where do mosquito breed and, thus the need of the *aegypti*-control activities.
✓	X	46·5**%** (550 ind.)	Residents identified water-containers but also other false issues (food debris and pets) as mosquitoes' breeding inducers . These residents did not comprehend what lead to the breeding of new mosquitoes and, thus did not understand the proposed measures to control them.	Residents seemed to not understand where mosquitoes breed and neither the need of the *aegypti*-control activities. Alleged Myths 11 and 12: "Clean houses or houses without pets/animals do not have mosquitoes" or "Clean people did not need to be involved in mosquito control".
X	✓	12·0 (142 ind.)	Residents did not identify water-containers neither other false issues (food debris and pets) as mosquitoes' breeding inducers. These residents did not know where mosquitoes breed.	Residents seemed to not understand where mosquitoes breed and neither the need of the *aegypti*-control activities.
X	X	13·9 (164 ind.)	Residents did not identify water-containers but did identify other false issues (food debris and pets) as mosquitoes' breeding inducers	Residents are completely mistaken regarding mosquitoes breeding, thus did not understand the need of the *aegypti*-control activities. Alleged Myths 11 and 12: "Clean houses or houses without pets/animals do not have mosquitoes" or "Clean people did not need to be involved in mosquito control".
Concept 9	**Concept 10**	**%**	**Control Measures**	
✓	✓	13·0 (154 ind.)	Residents only recognized water-containers removal (and not other false measures) as "effective to control mosquitoes"	Residents seemed to recognize effective control measures and, thus understand how the domestic *aegypti*-control should be done.
✓	X	64·1 (758 ind.)	Residents recognized water-containers removal and also other false measures (such as insecticide indoor application and flyswatter use) as "effective to control mosquitoes"	Residents seemed to not be focused on effective control measures and, thus did not understand how the domestic *aegypti*-control should be done. Alleged Myth 13: "Using insecticides or the flyswatter, I am already contributing to control the *aegypti*-mosquito"
X	✓	7·3 (86 ind.)	Residents did not recognize water-containers removal neither other false measures (such as insecticide indoor application and flyswatter use) as "effective to control mosquitoes". These residents did not know how to control mosquitoes.	Residents not recognized effective control measures and, thus did not understand how domestic *aegypti*-control should be done.
X	X	15·6 (184 ind.)	Residents recognized water-containers removal and also other false measures (such as insecticide indoor application and flyswatter use) as "effective to control mosquitoes"	Residents seemed to not be focused on effective control measures and thus did not understand how the domestic aegypti-control should be done. Alleged Myth 13: "By using protective measures (such as insecticides or flyswatter), I am already contributing to control the *aegypti*-mosquito"

Additional file II.1.5 – Domestic breeding sites: Percentage (%) of inquired residents living in houses with each type of breeding site (n Total =1276)



Additional file II.1.6 - Domestic breeding sites predictors: Associations/differences with socio-demographic data

	Residents living in houses WITH BREEDING SITE(S) n total = 1018		Residents living in houses WITHOUT BREEDING SITE(S) n total = 261		
	n	**%**	**n**	**%**	***p*-value**
Gender					0·665
Male	406	40·2	100	38·8	
Female	603	59·8	158	61·2	
Education level (years)					0·007
Never studied (0)	62	6·2	13	5·1	
Fourth Grade (4)	402	40·4	82	32·2	
Ninth Grade (9)	226	22·7	55	21·6	
High School (12)	171	17·2	49	19·2	
Upper Education (+12)	135	13·6	56	22·0	
Age groups (years old)					0·002
25 or younger	147	14·7	23	9·0	
26-35	144	14·4	28	11·0	
36-45	145	14·5	52	20·4	
46-55	176	17·6	45	17·6	
56-65	156	15·6	26	10·2	
66-75	137	13·7	48	18·8	
76 or older	96	9·6	33	12·9	
Municipal Division					<0·001
Santa Luzia	281	27·6	136	52·3	
São Pedro	271	26·6	43	16·5	
Câmara de Lobos	466	45·8	81	31·2	
Travelled to DEC					0·204
yes	240	24·2	71	28·1	
no	752	75·8	182	71·9	
'Bitten by mosquitoes'[10]					0·273
yes	744	73·6	200	76·9	
no	26	26·4	60	23·1	
' chi-square test (Pearson test)					

[10] also mentioned as AME – admitted mosquito exposure

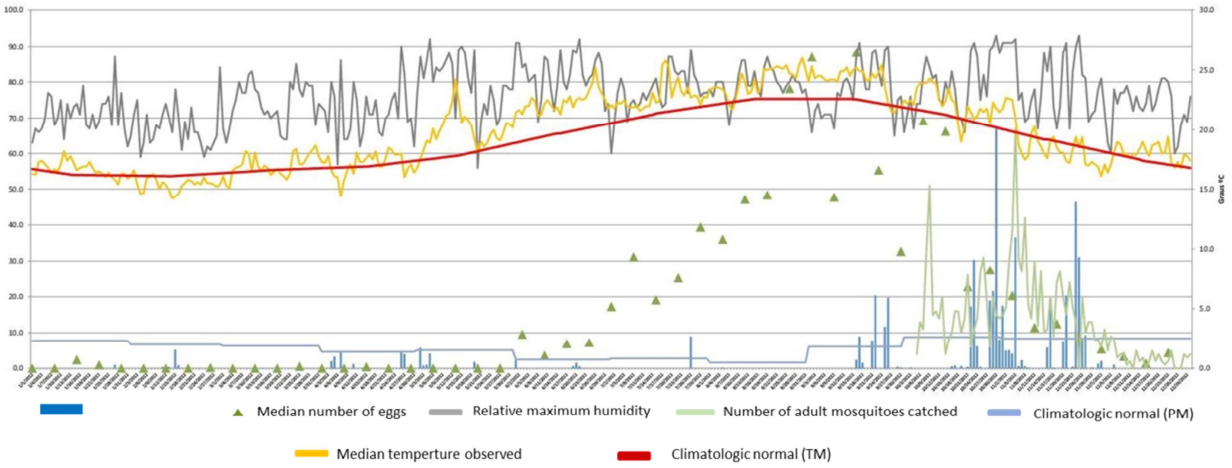
Additional file II.1.7 – Multiple regression model predicting socio-demographic determinants to achieve at least seven perceived essential concepts (EP-score equal to or higher than seven)

	OR and 95% CI:	Lower	Upper	***p*-value**
Constant	1·456	-	-	0·385
Gender				
Male	0·579	0·419	0·800	0·001
Female a	-	-	-	-
Education level (years)				
Never studied (0)	28·940	6·490	129·047	<0·001
Fourth Grade (4)	11·425	6·662	19·590	<0·001
Ninth Grade (9)	4·370	2·717	7·030	<0·001
High School (12)	2·116	1·357	3·302	0·001
Upper Education (+12) a	-	-	-	-
Age groups (years old)				
25 or younger	1·676	0·753	3·733	0·206
26-35	0·874	0·419	1·820	0·718
36-45	0·700	0·349	0·402	0·314
46-55	0·712	0·759	1·411	0·330
56-65	0·730	0·359	1·481	0·383
66-75	0·919	0·453	1·865	0·816
76 or older a	-	-	-	-
Municipal Division				
Santa Luzia	0·479	0·304	0·753	0·001
São Pedro	0·701	0·445	1·104	0·126
Câmara de Lobos a	-	-	-	-
Travelled to DEC**				
Yes a	-	-	-	-
No	1·174	0·817	1·688	0·385
'Bitten by mosquitoes' [11]				
Yes a	-	-	-	-
No	1·789	1·189	2·693	0·005

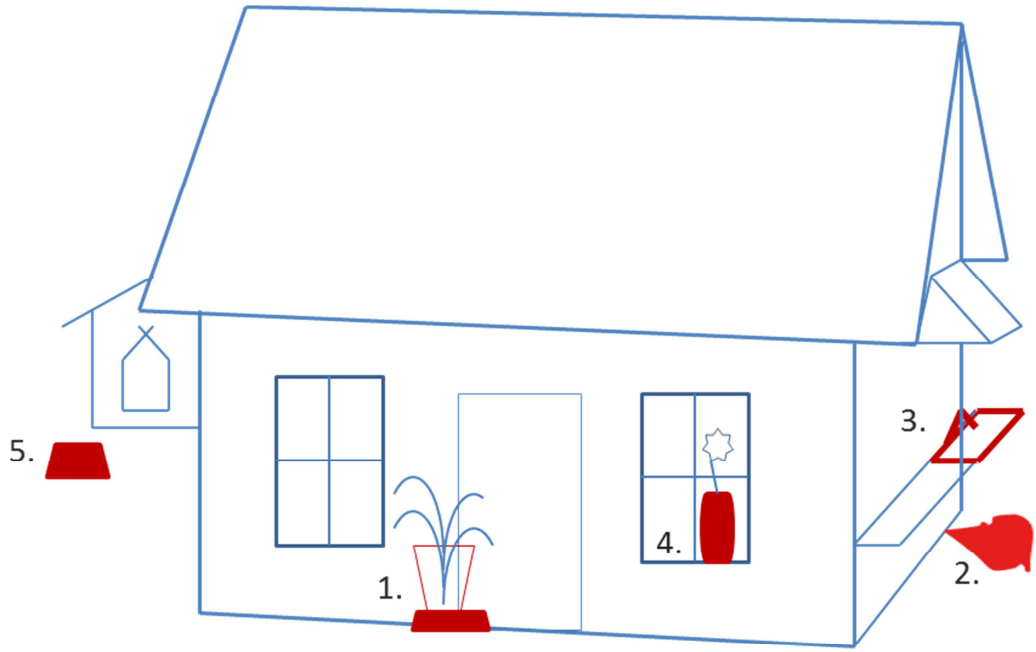
a Reference

[11] also mentioned as AME – admitted mosquito exposure

Additional file II.1.8 – Variation of the temperature, humidity and precipitation from September 2011 to July 2012 in Madeira Island



Additional file II.1.9 – Representation of the *A.aegypti* infestation pattern found in the domestic regions of AEGYPTI-area in Madeira Island



1. Flower-pot dish (52·7%)
2. Water-accumulation on deck* (35·7%)
3. Outdoor sink **(23·3%)
4. Flower vases (21·7%)
5. Pets water dish (18·8%)

* Floor slope; uneven floor;

** outdoor kitchen; clothe water tank; floor drains

II.2 – ASSESSMENT OF PERCEPTION REGARDING BROAD DENGUE PREVENTIVE ISSUES[12]

(STUDY 1, PART 2)

The data analysed and presented here constitutes the second part of the PRE-outbreak study 1. Its data collection occurred within the same cross-sectional survey described in sub-chapter II.1. Therefore, common subjects of background and methods sections will not be repeated.

[12] results from this sub-chapter were invited by Direcção Geral de Saúde to publish in a non-indexed scientific journal (Saúde em Números)

BACKGROUND

As mentioned in the Background section of the earlier sub-chapter (II.1), studies that reinforce community-based *aegypti*-control in Madeira are undoubtedly of great local and international interest. For that, the assessment of public perceptions is crucial to detect how community "sees" dengue and dengue prevention.

Besides the selected dengue-preventive behaviour (source reduction), analysed in sub-chapter II.1, there are other dengue-related issues which analysis can contribute to better assess community perception. Consequently, the PRE-outbreak questionnaire survey, which was the first representative dengue epidemiologic survey performed in Madeira, also covered topics such as, dengue symptoms, local mosquitoes and consequent concerns. The questionnaire also included open questions in order to encourage the public to "say what they think by their own words". Compared with the closed questions, open questions are more difficult to analyse, but they may provide crucial and sometimes surprising data, since they do not force the respondent to choose one out of those stated in the questionnaire, restricting public answers.

This work aims to analyse all these questions which, even though comprised in the same PRE-outbreak questionnaire, were not analysed in the previous sub-chapter.

METHODS

Data was collected in the questionnaire mentioned in sub-chapter II.1 (see 'Questionnaire' sub-section, sub-chapter II.1). Questions herein analysed were focused on the following subjects: community concerns regarding mosquitoes (three questions), local mosquitoes (two questions), dengue fever (three questions), mobility to endemic countries (three questions), media-based strategies (two questions) (Table II.2.1).

Frequencies from all answers were directly estimated, except for open questions that were formerly categorized according to basic thematic analysis.

TABLE II.2.1 – TOPICS COVERED IN THE QUESTIONNAIRE, RESPECTIVE QUESTIONS, FIGURES AND TABLES

Subjects	Question	Results presented
Concerns about generic mosquitoes	"In your residential area, do mosquitoes worry / concern you in anyway, or not, or maybe you never thought about it? "	Figure 1 – Community concern
	IF YES "to what level do you worry about mosquitoes?" (subsequent from the previous question)	Figure 2 – Level of concern
	IF YES "Why is it a cause of concern?" (subsequent from the first question of this group)	Figure 3 – Causes of concern
Local Mosquitoes	"How do you describe it?" (subsequent from the previous question)	Figure 4 – Vector description
	"In your opinion, what induces mosquito breeding? e)-Are there other causes?" IF YES, "Which ones?"	Figure 5 – Other mosquito breeding inducers
Dengue fever	"How can one catch Dengue disease?"	Figure 6 – Dengue's mode of transmission
	"Which are the symptoms of who becomes sick with Dengue?"	Figure 7 – Dengue's symptoms
	"Do you know any country in the world where Dengue disease exists?"	Table 1 – Dengue endemic countries
Mobility to endemic countries	"Have you ever travelled or lived in any country of Africa Americas, Australia or Asia?" IF YES, "Which ones? When did you come back? (subsequent from the previous question) IF NO, "Do you have family or friends that have travelled or lived in any country of Africa Americas, Australia or Asia?"	Table 2 - Most visited endemic countries (Answers were re-categorized including together people, families or friends that travelled or lived in any endemic country/region)
Media- based strategies	"Have you ever heard or read about "Dengue" disease? IF YES, Where? a) Newspapers or Magazines, b) Flyers, c) Street Posters, d) Television, e) Radio"	Figure 8 – Media talking about dengue
	"Other sources? Which ones?" (subsequent from the previous question)	Figure 9 – Other media talking about dengue

RESULTS

A total of 1276 individuals answered the above described questions. The study sample was represented by 40.6% male and 59.4% female subjects. The average age in this study was 49.9 years (SD=19.04 years, min=18

years and max=91 years). In what concerns the respondents' level of education, 5.9% did not study at all, 38.2% had only completed the fourth grade, 22.5% studied until the ninth grade, 17.7% finished high school or similar and 15.7% graduated or had a master or postgraduate degree. There were 311 individuals (24.4%) that admitted to have already travelled to dengue endemic countries (DEC) and 319 individuals (25.0%) that never travelled to those regions but that have friends or family that did it (out of 1276 in both cases).

Most of the respondents revealed to be concerned about mosquitoes, the majority of those declared to be «very» or «greatly» concerned (Figures II.2.1 and II.2.2). The causes of concern mostly pointed out were related to: 'allergies', 'health' or 'family' (Figure II.2.3).

FIGURE II.2.1 – COMMUNITY CONCERN ABOUT MOSQUITOES
Proportion of residents that admitted to be or not to be concerned about mosquitoes, and also those that admitted never having thought about it (%, n= 1276) (note: 6 did not answered)

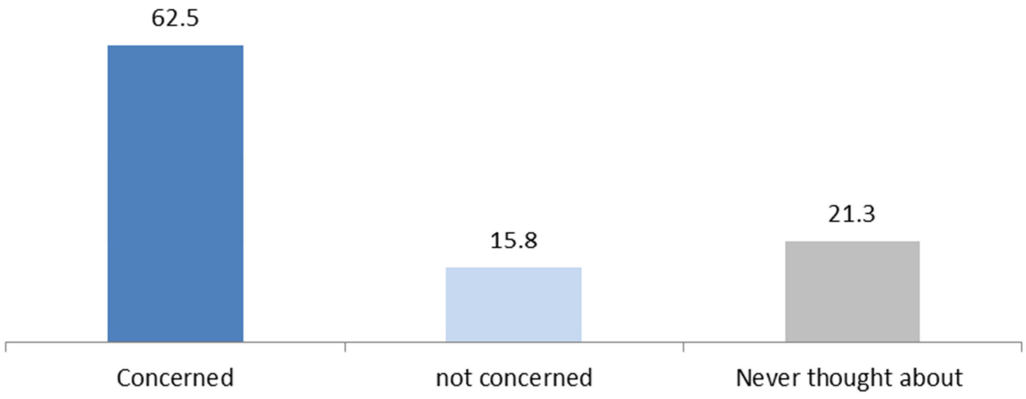


FIGURE II.2.2 – LEVEL OF CONCERN
Proportion of residents, by level of concern, which admitted to be concerned about mosquitoes (%, n= 770)

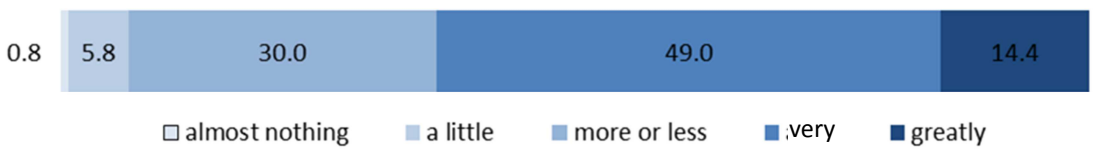
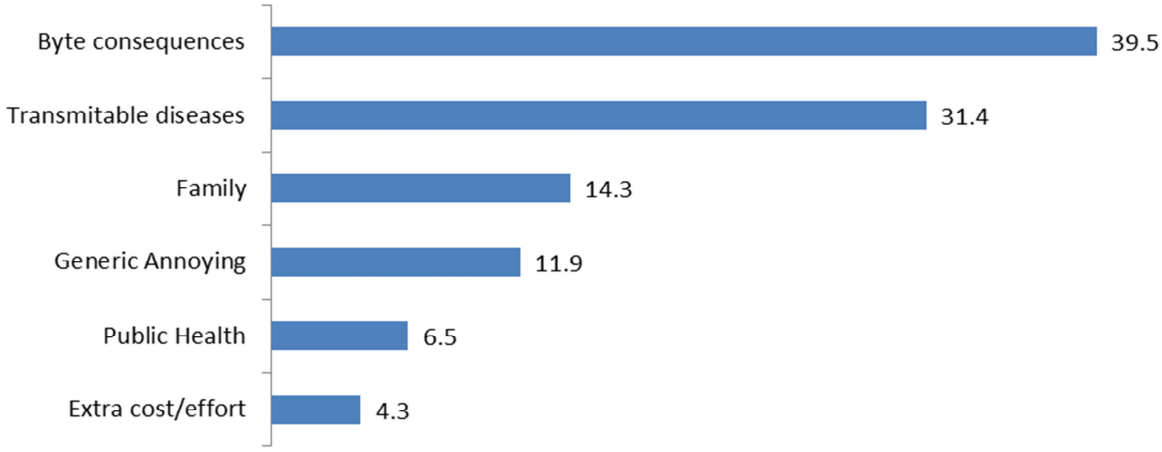
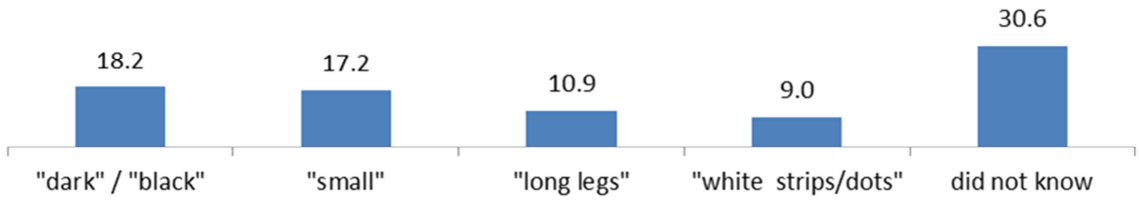


FIGURE II.2.3 – CAUSES OF CONCERN
Proportion of residents that have admitted cause(s) of their concern about mosquitoes (%, n= 797 – those that admitted to be concerned)



Out of those who recognized the presence of vectors in their residential area (39.4%, 412/1045) the majority (58.2%, 240/412) either admitted not knowing how to describe *A. aegypti* or described it incorrectly. Moreover, the remaining, who described *A. aegypti* appropriately, did so by covering five main characteristics: its «darkness», its «small size», its «long legs», its «white strips», «white dots» or «white legs» and some behavioural features. The most frequently mentioned adjectives were generic ones, such as «small» or «dark», while the more specific feature «white strips» was the less mentioned one (Figure II.2.4).

FIGURE II.2.4 – VECTOR DESCRIPTION
Most frequently mentioned vector´s characteristics. Proportion of residents (out of those who recognized *A. aegypti* presence in their local residence) that stated one or more *A. aegypti* features (%, n= 412).

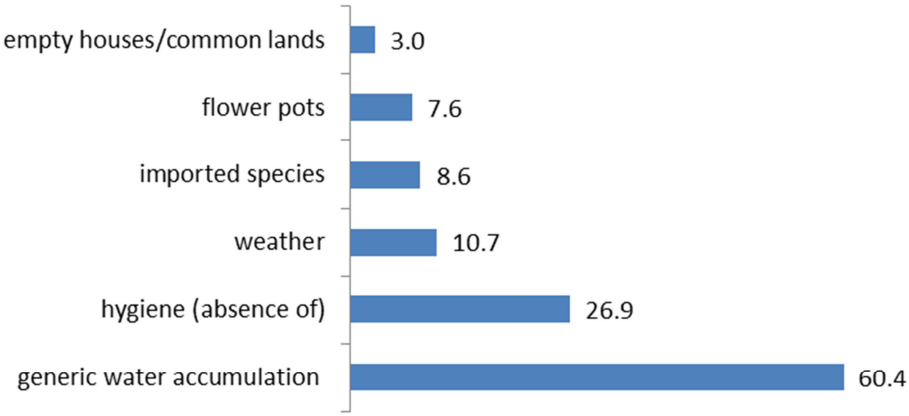


Out of those who did not recognize the presence of vectors and those who believed that mosquitoes could not transmit diseases (who sum-up to a total of 864 individuals), the majority (54.5%), when shown the actual *A. aegypti* mosquito, admitted to having already seen it. However, out of these majority of 54.5% individuals, very few correctly identified it as «*Aedes aegypti*» (5.1%, 24/471). The remaining mentioned other broad names such as «mosquito» (31.0%, 146/471) or «Santa Luzia's mosquito» (12.7%, 60/471).

Figure II.2.5 presents the answers given by residents when asked about the eventual existence of other mosquito breeding inducers[13] not mentioned in the multiple choice question. The term "other" refers to mosquito breeding inducers separate from the ones mentioned in the previous question analysed in the sub-chapter II.1 (pets, food debris, plants or water containers). A total of 229 individuals believed that mosquito breeding can be induced by other inducers. According to the residents' answers and to the categorization applied, these other mosquito breeding inducers were: 'generic water accumulation' (referred by 60.4%), 'absence of hygiene' (26.9%), 'weather' (10.7%), 'imported species' (8.6%), or 'empty houses/common land' (3.0%), as described in Figure II.2.5. Answers included in the 'generic water accumulation' category refer to a range of different meanings such as, «wells», «lakes», «streams», «ponds», «water-accumulation on deck» and «flower-pot dishes».

[13] situations or occurrences that will promote mosquito development

FIGURE II.2.5 – OTHER FACTORS OR SITUATIONS THAT PROMOTE MOSQUITO BREEDING
Resident´s beliefs (one or more) regarding other mosquito breeding inducers stated as an answer to an open question (%, n=197 – all residents that answered to this question).



Considering the media-based tools that transmitted dengue-related information, 'television' was the most efficient in spreading the term «dengue» within AEGYPTI's residents, when selected in a multiple-choice question (Figure II.2.6). However, through an open answer question, the 'web', 'travels to foreign countries' and 'word-of-mouth' were also mentioned means of communication in «dengue» dissemination (Figure II.2.7.

FIGURE II.2.6 – MEDIA-BASED STRATEGIES
Proportion of residents that heard/read about dengue in different mass communication sources (%, n= 770)

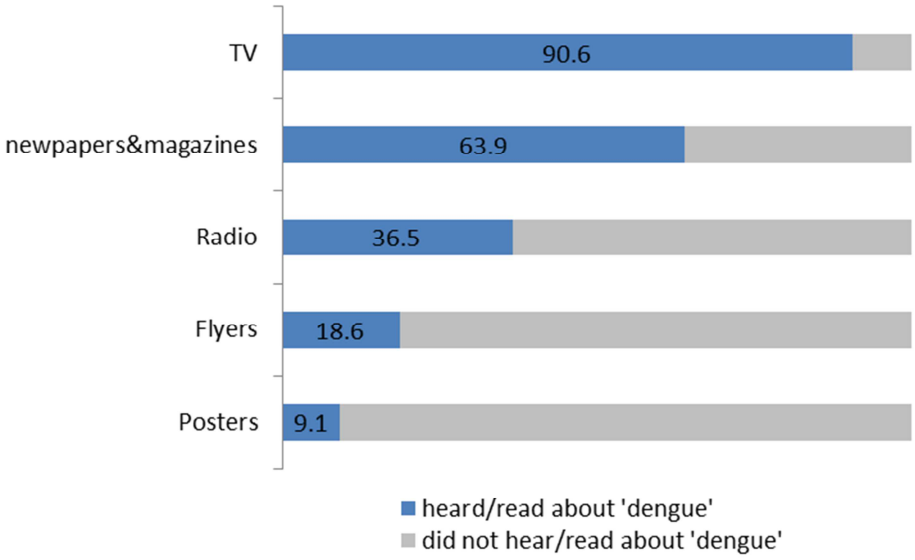
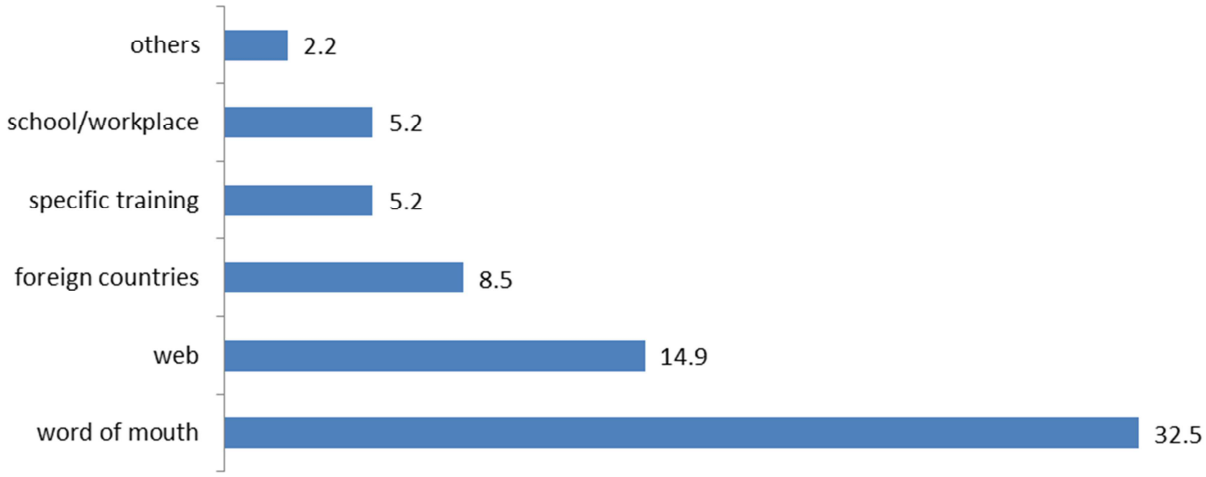


FIGURE II.2.7 – OTHER COMMUNICATION STRATEGIES USED TO DIFFUSE MESSAGES ABOUT DENGUE

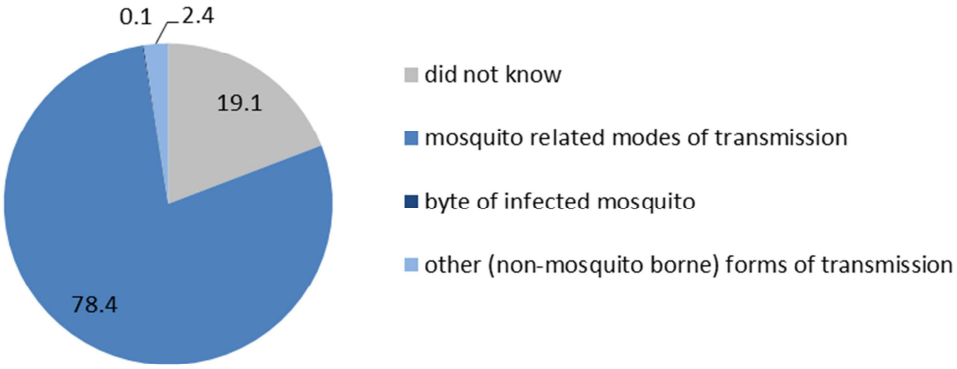
Proportion of residents that heard/read about dengue through other(s) communication sources (%, n= 340 – all residents that answered to this question)



In what concerns the dengue disease awareness, 63.1% had already heard about «dengue». Out of those, 78.4% recognized that dengue is transmitted by some kind of mosquito activity and only 0.1% knew that the transmission is done through the byte of an infected mosquito (Figure II.2.8).

FIGURE II.2.8 – DENGUE'S MODE OF TRANSMISSION

Residents beliefs regarding the dengue mode of transmission (%, n=798 - those that have recognized the term 'dengue' were the total inquired about its transmission)

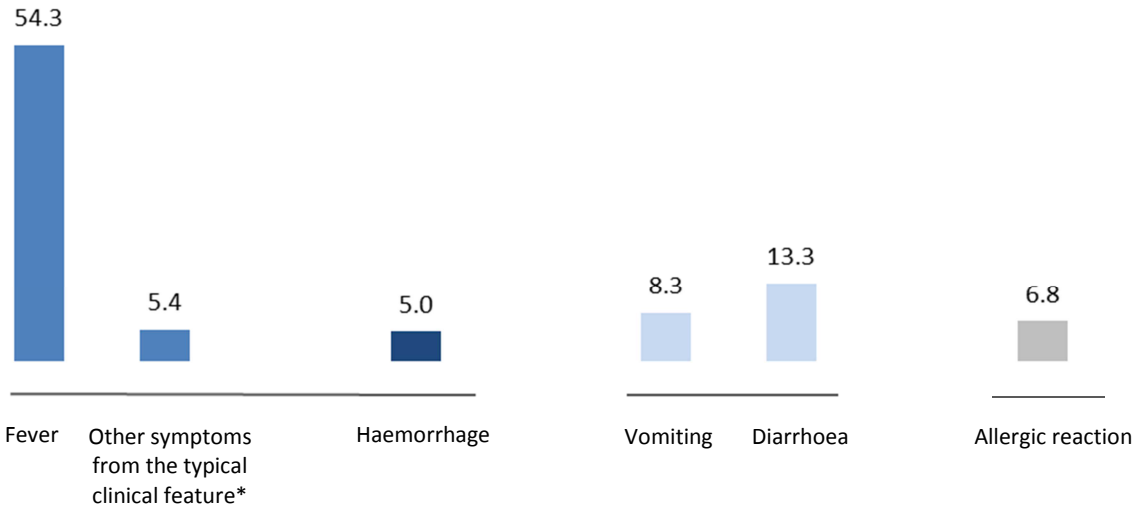


When asked about dengue symptoms, approximately half of those inquired mentioned «fever» (54.3%). There were only 5.4% who enumerated the

more specific dengue symptoms, such as retro-orbital or muscle or bone pain. Moreover, a higher proportion (6.8%) erroneously mentioned «allergic reactions» as dengue symptom (Figure II.2.9).

FIGURE II.2.9 – DENGUE SYMPTOMS

Residents' beliefs regarding symptoms of dengue infection (%, n= 798- those that have recognized 'dengue' are the total inquired about symptoms)



* according to WHO/CDC: headache, joints pain, eye (retro orbital) pain, muscle and/or bone pain, rash

- Left group - symptoms of DF/DHF typical clinical feature;
- Left group (darker) – symptom from the DHF typical clinical feature;
- Central group - symptoms which are not from the typical clinical feature of the dengue/dengue hemorrhagic syndrome;
- Right group - mosquito bite consequence (not related to DF/DHF

When asked to identify DEC, almost half of those who recognized «dengue» recognized Brazil as a DEC (45.5%). Angola was the second most mentioned country (12.8%). A total of 24.1% individuals, more than the double of those that mentioned Venezuela, had generally cited the African continent in the same question (Table II.2.2).

TABLE II.2.2 – CITED ENDEMIC COUNTRIES

The three most referred endemic countries, their last year of dengue outbreak and correspondent number of cases.

Country	n	%	Year of the last outbreak*	No. of cases
Brazil	363	45.5	2011[154]	56882
Angola	102	12.8	1980 [44]	?
Venezuela	82	10.3	2010 [155]	124931
Angola + Mozambique + 'Africa' **		24.1	n/a	n/a

* at the date of this survey was performed;

n (total) =798 - those that have recognized 'dengue' are the total inquired about endemic countries.

** considering altogether residents mentioning "Angola", "Mozambique" or "Africa".

Brazil and Venezuela have been the first two most visited endemic countries in the past five years, by the inquired individuals or their relatives/friends (Table II.2.3). Angola was the third most visited DEC, but considering those who had also mentioned their returning date, the majority of those who travelled to Angola did it more than 30 years before the study had been performed. An association was found between the respondents who visited Angola and those who have mentioned it as a DEC ($p<0.001$).

TABLE II.2.3 – MOST VISITED ENDEMIC COUNTRIES
Left side –endemic countries most visited in any period of time, travels done by the respondent, their family or friends (n =630 – all that have travelled or that have family/friends that have travelled to those countries) ; Right side - Most visited endemic countries in the last five years regarding travels done by the respondent, their family or friends. (n=119 – individuals who have reported the returning date of travels to endemic countries).

All returning dates			In the last 5 years		
Country	**n**	**%**	**Country**	**n**	**%**
Venezuela	307	48.7	Brazil	47	39.5
Brazil	194	30.8	Venezuela	47	37.8
Angola	69	11.0	Others*	32	26.8
USA	54	8.6	USA	10	8.4
Australia	52	8.3	Cape verde	9	7.6
Mozambique	49	7.8	Angola	4	3.4

*Argentina, Australia, Burkina Faso, Cape Verde, Caribbean archipelago, China, Colombia, Hawaii archipelago, India, Macau, Malaysia, Mexico, Mozambique, São Tome and Príncipe, Thailand,Vietnam

DISCUSSION AND CONCLUSIONS

The community's perceptions assessed revealed an incipient knowledge and awareness regarding the explored subjects: *A. aegypti*'s physical feature, mosquito breeding inducers, modes of dengue transmission and dengue-syndrome symptoms. Even though some of these questions had a high percentage of correct answers, only generic perceptions (not directly related to DF or *A. aegypti*) were revealed. These results could be explained taking into account that this region did not have any historical experience of autochthonous dengue cases. Moreover, the last European dengue outbreak occurred 84 years ago [35].

Residents who describe *A. aegypti* as «dark» or «small» most probably are not able to identify it or distinguish it from other mosquitoes in their daily routine.

Very few respondents revealed to be ready for recognizing dengue symptoms. The most mentioned dengue symptom, fever, can also be a symptom of flu, cold, or any other infection. Those who mentioned «allergic reactions» reinforced the misperception of dengue health risks (myth 2, described in Table II.1.2). As a matter of fact, 96.3% of those who mentioned «allergic reaction» did not mention any other dengue-specific

symptom. Dengue implicates a mosquito bite which may provoke an allergic reaction. Even though, if one does not mention other dengue specific symptoms, one is probably referring to the nuisance that a mosquito bite could bring even when uninfected, thus undervaluing the clinical impact of a dengue-infective bite. Findings about the dengue mode of transmission support the latter consideration. In fact, the majority of people associated dengue with mosquito, but not with an infection, also corroborating the presence of myths 1 and 2 (Table II.1.2).

As expected from an open question, mosquito breeding inducer results (Figure II.2.5) did not describe the weight of each answer, but rather suggested ideas or beliefs that had not been mentioned in the close multiple-choice answers. 'Absence of hygiene', 'weather' and 'empty houses/common lands', are examples of categories of the answers mentioned by the community as situations that promote mosquito breeding, these ideas or beliefs. By believing in the existence of these inducers residents may lose compliance to the removal of actual *aegypti*-inducers (water accumulation in domestic containers). In fact, the absence of hygiene could be an inducer of *A. aegypti* mosquito proliferation, since rubbish and garbage could accumulate water, especially when spread in outdoor areas. However, this is not the most common case of Madeira, as shown in the findings of the entomological characterization (Additional File II.1.5). The breeding site 'rubbish (on the floor)' was found ten times less than the most frequently found 'flower pot dishes' presented in 52.7% of the infested area houses. Therefore, the belief in the absence of hygiene as an inducer of *A. aegypti* proliferation in Madeira is not entirely correct, and can mislead those who believe in it, by suggesting the erroneous ideas that «clean houses do not have mosquitoes» and «people living in clean houses have nothing to do concerning mosquitoes» (myth 11 and 12, described in Table II.1.2).

The role of temperature, humidity and rainfall on mosquito survival and ecology is well known. Therefore, the belief that the 'weather' is a mosquito breeding inducer is partially true. However, it is also known that other non-climate factors, such as the domestic environment and the close

association of *A. aegypti* with humans, have a higher impact in species' survival than climate [6,134].

Regarding 'empty houses/common lands' they could represent continuous and inaccessible breeding sites, there is no evidence that can either confirm it or deny it. However, they are very frequent in Madeira's most-infested areas, and most of them are surrounded by inhabited buildings. Therefore, special attention should be given to these putative inducers.

Still regarding mosquito breeding inducers, the heterogeneity within the classification 'water-accumulation', pointed out that there are people who believed that *A. aegypti* breeds in larger water collections (*e.g.* streams that cross all the Island territory) than the ones where it actually breeds. This reinforces the need to clarify the *aegypti*-breeding sites in subsequent campaigns.

'Imported species' was also mentioned as a mosquito inducer. This could mean a 'negative feeling' towards the authorities, private, or corporate decisions to import species/goods or the way the species/goods were imported. This lack of empathy with past decisions, involving circumstances beyond the community's control, may diminish civic responsibility and weaken the proposed and promoted 'collaborative feeling', both determinant issues in effective community engagement.

Since some above mentioned issues (weather, empty houses/common lands, imported species and big water accumulation) are things or conditions that are out of the residents' management, they may feel that these mosquito-inducing factors can possibly cancel their own efforts to eliminate breeding-sites, thus, discouraging them to start and continue their domestic *aegypti*-control. It would be of great value to clarify to the community on whether or not these factors are promoting the mosquito proliferation and if yes, to visibly treat them.

Looking at media-based strategies to promote dengue and mosquito control, one could expect that 'television' and 'radio' would reach more people than posters or flyers, probably because both the latter transmit not only official advertisements but also dengue-related news. However, the radio reached much less people when compared to television. This may

suggest that AEGYPTI residents listen to the radio much less frequently than they watch television. Consequently radio communications are probably less efficient. 'Web' and 'school/workplace activities' also reached the community, and are therefore putative alternatives to the most standard ways of health message dissemination.

Regarding the subject of DEC, it was curious to observe that the African continent (where the last dengue outbreak report was 30 years before the survey had been performed) was mentioned by twice the amount of individuals than those who had mentioned Venezuela (which has dengue outbreaks almost annually). Two hypotheses could be speculated to explain why Angola and Africa were as much mentioned as a DEC. On one hand, community could retain the idea that Africa, by generally being a low-income territory is the "home" for every tropical disease. In fact, historically the majority of the tropical diseases were present in poor communities. Moreover, the most commonly called «Neglected tropical diseases» define «a group of parasitic and bacterial diseases (…) affecting the world's poorest people» [156]. All these reinforces an eventual association between tropical diseases and poverty. On the other hand, confusion could exist between dengue syndrome and malaria. The latter is indeed wide spread in Angola and in most sub-Saharan African countries and its early symptoms are not that different from those of dengue fever. The association found between people that visited Angola and those that have mentioned it as a DEC could support the last hypothesis. The similarities between the clinical symptoms of malaria and dengue have already been mentioned in the literature as the cause of diagnosis confusion and erroneous notification of these diseases [157].

The Madeira's community had reasons to be concerned about the fact that the most visited countries, Brazil and Venezuela, have regular outbreaks of dengue.

In conclusion, this survey provided critical insights about the perception of dengue and its prevention in non-endemic dengue areas. Present findings are not only of great value to improve prevention efficacy in Madeira Island

but also to strengthen preparedness to dengue outbreaks in temperate non-endemic regions.

CHAPTER III: POST- OUTBREAK WORK

This chapter presents the work performed after the outbreak. It comprises two different surveys described in separate sub-chapters. The first sub-chapter (III.1) covers results from an inquiry by questionnaire survey (study 2) and the second sub-chapter (III.2) covers results from a qualitative survey using focus group sessions (study 3), both assessing community perception regarding domestic source reduction. Sub-chapters III.1 and III.3 accomplished objectives 6 and 7 respectively.

For comparative purposes, in sub-chapter III.1 the first part of the Study 1 will be mentioned as 'PRE-outbreak study' and the Study 2 will in this sub-chapter be refereed as 'POST-outbreak study'.

III.1 - «IMPACT OF A DENGUE OUTBREAK EXPERIENCE IN A TEMPERATE REGION: FORWARD AND BACKWARD STEPS OF COMMUNITY PERCEPTIONS»[14]

(STUDY 2)

[14] To be submitted

ABSTRACT

The ability to effectively promote behaviours is more and more relevant to attain and maintain a good individual and collective health status. For the last years several models and theories have been proposed to explain behaviour-change, covering two main approaches for (healthier) decision-making: one analytical/logical and one experiential/emotional/intuitive. According to the former approach, community perception assessments frequently measure cognitive issues. However, few studies explore how past experiences impact public views in particular health-risk contexts, impeding an integral and dynamic understanding of the behaviour change process. Before Madeira's first dengue outbreak (in 2012), community perceptions regarding domestic source reduction, were assessed. This offered a unique opportunity to assess and compare community perceptions before and after the experience of the dengue outbreak, and this was the aim of this study.

A cross-sectional survey was performed within female residents at the most *aegypti*-infested areas. Perceptions regarding the main dengue-preventive behaviour were assessed according to the Essential Perception (EP)-analysis tool. A matching process (or randomised block design) was used in order to pair individuals from studies performed before and after the outbreak, ensuring homogeneity in 6 determinants variables.

After the outbreak, there were more female residents that assimilated the concepts considered to be essential to understand the proposed behaviour. Nevertheless, no significant difference was observed in the number of female residents who achieved the defined 'minimal understanding'. Moreover, as observed before the outbreak, most of the population (95.5%) believed at least in one of the identified myths. Even though, the number and frequency of myths did not change significantly, some myths disappeared and others, which were absent before the outbreak, had appeared.

In the present study we were able to quantify how the experience of a risk event influenced the perception regarding a dengue-preventive behaviour.

Results have shown that the assimilation of several relevant concepts improved. This experience have also surprisingly led to the appearance of new myths within the population, apart from the general decrease of the previous myths' frequency. Monitoring public perceptions is therefore crucial to make preventing dengue campaigns updated and, thus, worthy. Lessons from this work can be useful not only for local authorities but also for dengue-related professionals and researchers in public-health, decision-making or experience-integration.

BACKGROUND

Most of the worldwide major causes of death (MCD) in 2011, rely on behaviour changes for their prevention [158]. In fact, increasing physical activity, fruits/vegetables intake, hand-washing, use of condoms and decreasing not only fat, salt and sugar intake but also smoking habits, are crucial in the control of heart disease (1st MCD), stroke (2nd MCD), chronic obstructive lung disease (4th MCD), diarrhoea (5th MCD), HIV (6th MCD), or diabetes (8th MCD). Behaviour changes are increasingly relevant to attain and maintain a good health status, especially when facing health threats for which there is no efficient or timely treatment. This is the case for dengue fever that, such as other mosquito-borne diseases, requires a good compliance to certain preventive, protective or therapeutic actions. Moreover, since there is no vaccine nor treatment for dengue fever, neither 100% effective insecticides, community behaviours have a huge impact on its prevention and control [21].

It is still not widely understood how to effectively promote behaviour changes [106]. In fact, during several decades many behaviour impact campaigns have shown to be fruitless. In the last 50 years, extensive literature, presented theoretical models that tried to clarify cognitive ways for (healthier) behaviour acquisition [63,76]. More recently, the concept of 'past experiences' has been stated as also being crucial in determining (healthier) decision-making. Countless authors claim that due to the type of emotions and intuition that they produce, 'past experiences' can stoutly

encourage or discourage a particular action [10-16]. Altogether, these contributions seem to present two different approaches by which humans perceive decision-making and then make decisions: one analytical and one experiential [14,15]. In order to improve the efficacy of the behaviour-promoting messages, these authors strongly suggest that messages should be meaningful as well as affectively adequate for the targeted community. This way, the assessment of community's cognitive and emotional perceptions, is hence useful in the guiding of effective health-seeking messages. However, few studies explore emotional experience-driven perceptions but rather frequently only focus on the assessment of the cognitive ones [71].

Some evidence has suggested that experience can influence public perceptions and reactions in two ways [72,73]. On one hand, it can over-estimate the risk perception [17,18] (*i.e.* alert-feeling, also mentioned as 'availability bias' [163]) and consequently, promote protective/preventive actions. On the other hand, it can underestimate the risk perception [20-22] (*i.e.* habituation effect also mentioned as 'gambler's fallacy' [163]) and hence, discourage protective/preventive actions. However, very few studies have explored this issue in real situations. Surveys that explore in what way and how much past experiences impact public views or actions in particular health-risk contexts are of great need [103]. Besides the scientific interest of scrutinizing the complex process of (healthier) decision-making, the monitoring of public perceptions and behaviours contributes to the continuous and adequate update of the behaviour-promoting messages concerning their (rational and emotional) content. This is the case of any chronic and endemic disease, where the (health) risk is maintained during time such as dengue risky, endemic and endemic areas [103].

Madeira archipelago was colonized by a dengue vector species, *Aedes aegypti*, in 2005 and suffered the first dengue outbreak in 2012 [139]. Community perception regarding preventive behaviours (domestic source reduction) was assessed and described in detail before the outbreak had been declared (presented in sub-chapter II.1) [166]. With the end of the

outbreak, a unique opportunity to explore and compare community perception before and after the outbreak had appeared. This was the aim of this study, which constitute the first report on the effect of an outbreak experience on community perceptions regarding a specific vector-borne disease.

METHODS

To our knowledge, the results presented here constitute the first report on the effect of a disease outbreak experience on community perceptions.
In order to ensure an accurate comparison between public perceptions before and after the dengue outbreak in Madeira Island, present survey tried to follow as much as possible the methodology used in the prior-to-the outbreak survey (herein mentioned as PRE-outbreak study) [166]. Therefore, the tool used in the assessment of the community perceptions was maintained, i.e., an 'Essential-Perception analysis' (described in the homonymous sub-section). However, due to ethic, time and logistic constrains implicit in the preparation and implementation of this survey during the outbreak and just after it, adjustments in the size of the studied area and in the sampling methodology, were introduced as explained in 'Studied population' sub-section. In order to overcome those constrains and guarantee an unbiased comparison, populations that were surveyed in both PRE/POST-outbreak studies were matched according to critical socio-demographic variables, as described in sub-section 'Matching Process'. The cross-sectional survey performed after the outbreak will be subsequently mentioned as POST-outbreak study.

STUDIED POPULATION

Due to the mentioned limitations, the studied area in the POST-outbreak study was not the same as the in PRE-outbreak one (Additional file 1 a), b)). Exclusively the urban part of the most *aegypti*-infested area was selected[15].

[15] PRE-outbreak study area was divided in two zones according to population density and economic activities. The first, with almost half of the demographic population of the other and a predominance of

Facing the impossibility of including both urban and rural parts, the urban part (Funchal District) was preferred based on two main reasons: (i) it corresponded to the area of maximum prevalence of dengue-cases during the outbreak (see Additional file III.1.1 c)); and (ii) it includes the capital city of the archipelago, Funchal, and thus an important point of *aegypti*-dispersion. In order to decrease the period of data collection, residents of part of 'Sé', 'Santa Maria Maior' and 'Imaculado Coração de Maria' municipalities were also included, besides those considered in the PRE-outbreak study ('São Pedro' and 'Santa Luzia'). The studied area limits were defined according to 2012 most *aegypti*-infested area in order to ensure a homogeneous level of natural exposure to the A. *aegypti* among the studied residents *(*Additional File III.1.1 d)). Analysis of the demographic data of the extra-included areas confirm that there are no significant differences between these and the previously studied, in what concerns the two critical socio-demographic determinants: age groups and education levels (Additional File III.1.2). The geographic area covered in the present study will be mentioned as 'Extended-AEGYPTI area' and consists of five Funchal's municipalities that belong to the most *aegypti*-infested area (Additional file III.1.1 b)).

An intentional sample of female subjects, residents in the Extended-AEGYPTI area, aged 18 years old or over, and who didn't integrate the previous PRE-outbreak survey was selected from customers of central hairdressers and pharmacies, placed in the selected area. All women who entered in the establishment and who met the inclusion criteria were invited to participate. Three reasons relied on the women preference: (i) before the outbreak they were significantly less aware to domestic source reduction than men (Additional file III.1.3); (ii) they are the majority within the studied population [144]; (iii) women above 15 years-old were the age/gender-group more affected by the disease during the outbreak [167]; and (iv) culturally, in Madeira Island, women are more related to the main dengue-preventive behaviour proposed than men do (see details about the

fishing activities is herein called as rural part (Câmara de Lobos) and the other is considered the urban one (Funchal). REF

behaviour proposed in 'Essential-Perception' subsection). The type of establishment were chosen in order to allow the study to cover the most possible heterogeneous women sample, in what concerns their age groups, education levels and socio-economic background. Two establishments of each service were chosen to participate in study, placed in the east and west boundaries of the studied area to promote participation of women from all the included municipalities. A sample size of 157 subjects was required to detect a difference of one point in the level of perception, fulfilling the objectives of this study - 95% confidence level and 80% of power (Additional file III.1.4 a)) [168]. A maximum variation of the score, 0-10 was assumed, based on what was observed in the PRE-outbreak study [166]. This sample size was inflated in 30% to account for incomplete interviews.

QUESTIONNAIRE

A cross-sectional survey was performed to assess residents' perceptions through face-to-face interviews. During the interview, a questionnaire comprising 21 questions was applied, covering dengue-preventive issues and personal-socio-demographic characteristics. In agreement with what was inquired in the PRE-outbreak study, questionnaire covered five main topics: 'Medical Importance' (two questions), 'Local Risk' (two questions), 'Domestic Attribute' (three questions), 'Mosquito Breeding' (three questions) and 'Control Measures' (three questions) [166]. The survey was performed by trained personnel from the local authority-IASAUDE, from 22nd of March until 16th of April, 2013. In each establishment (pharmacies/hairdressers), interviews were performed during a Monday-to-Saturday week, between 9am and 7pm (according to establishments' opening hours). Before data collection, establishments' managers/participants gave their written/oral informed consent respectively. Previous to the beginning of this survey, the questionnaire was pre-tested in a non-selected establishment placed in the selected area. The study was approved by *Instituto de Higiene e Medicina Tropical Ethics*

Committee, Instituto de Higiene e Medicina Tropical, Universidade Nova de Lisboa, Lisbon (reference: 09-2013-TD).

MATCHING PROCESS

Populations studied in both PRE/POST-outbreak surveys were matched into pairs, ensuring homogeneity in six critical socio-demographic variables. Resulting pairs of individuals were equal in (or "blocked" on) gender, education level, age group, municipal division, travels to DEC and admitted mosquito exposure (AME) variables, which were already shown to be determinants to the individual perception [166]. This sampling methodology can also be called as randomized block design, and the latter variables as blocking factors [169]. Since no significant differences were observed in the perception of consecutive ten-year age group and municipalities from Funchal, matchings were adjusted (Additional File III.1.5). Age groups covered individuals with a maximum difference of age equal to 20 years old, and residents of different municipalities of a unique district, were considered as belonging to the same 'municipal division'. For comparative purposes, an alternative matching without adjustments were also performed (basic matching). The matching models used (basic and adjusted) were built in Excel (Microsoft Office, Windows 8), and guaranteed that individuals were randomly selected within those that were personal-socio-demographically equivalent. Moreover, it was optimized in order to re-include all the non-selected individuals in the subsequent matching rounds.

ESSENTIAL- PERCEPTION ANALYSIS (PERCEPTION EVALUATION)

The assessment of the community perception was performed using the Essential-Perception analysis (EP-analysis), as described in the PRE-outbreak study [166]. Essential-Perception analysis assesses community perception regarding a particular behaviour proposal: the domestic *A. aegypti's* source reduction, considered the most critical dengue-preventive practice by the World Health Organization [124]. Basically it corresponds to the elimination (emptying, covering or removing) of water-containers

present inside or around residential buildings. In EP-analysis' theoretical, there are ten essential concepts which assimilation by individuals is needed to ensure the minimal understanding of the proposed behaviour (Table III.1.1). Essential-Perception analysis allows the characterization and estimation of the community's perceptions through four different approaches, all of them used here: (i) score of Essential-Perception, (ii) concept assimilation, (iii) topic understanding and (iv) myth identification and estimation. The first measures the number of concepts that were correctly assimilated (out of those defined to be 'Essential') by each individual, and how far is the studied population from the complete 'Essential Perception' (EP-Score = 10). The second describes how much those 'essential' concepts were assimilated or not-assimilated by the community. The third, organizes the 'essential concepts' in topics and describes how topics are/not being understood. Residents who have acknowledged both topic-related concepts are considered as having completely understood the topic, the acknowledgement of only one out of the two topic-related concepts is considered as a partial understanding of the topic, and residents who did not perceive any of the two topic-related concepts are considered as not having understood the topic. Finally the fourth, by analysing the concept assimilation, identifies erroneous beliefs, that may persist in the community, herein mentioned as 'myths', and estimate their putative frequency in the studied population.

TABLE III.1.1: LIST OF TEN CONCEPTS DEFINED AS ESSENTIAL WITHIN EP-ANALYSIS

Essential Topic	Essential Concepts
Medical Importance (MI)	MI1-concept- Transmission of disease through mosquitoes (bite)
	MI2-concept – Example of mosquito-borne diseases
Local Risk (LR)	LR1-concept - Presence of vector-mosquitoes in their own residential area
	LR2-concept - High possibility of a dengue outbreak in Madeira
Domestic Attribute (DA)	DA1-concept - Eventuality of indoor mosquito-breeding
	DA2-concept - Impact of domestic vector control
Mosquito Breeding (MB)	MB1-concept - Role of water-containers as breeding contributors
	MB2-concept – False role of 'pets' or 'food debris' as breeding contributors
Control Measures (CM)	CM1-concept – Source reduction as an effective domestic *aegypti*-control measure
	CM2-concept - 'Insecticide application' or 'use of a flyswatter' as an erroneous measure for the domestic *aegypti*-control')

STATISTICAL ANALYSIS (TEST STATISTICS)

All collected information was introduced and records were double-checked. Statistical analysis was performed using Excel (Microsoft Office, Windows 8) and Statistical Package for Social Sciences 19.0 (SPSS, Inc., Chicago, IL, USA). Answers obtained from the questionnaire were re-coded to obtain other categorical variables implicit in the EP-analysis. Comparisons of EP-score medians between populations from PRE/POST-outbreak studies were made using the non-parametric Wilcoxon Test, after ensuring its normal distribution through Kolmogrov-Smirnov test; (Table III.1.3). Additionally, the number of individuals that achieved an EP-score equal to or higher than seven (EP-score≥7) was compared between both studies. Differences were tested using the McNemar Test (Table III.1.4). This cut-off was chosen due to the lack of subjects that achieved an EP-score equal to ten (EP-score = 10). In order to confirm the methodology used during the matching process, comparisons between total and paired samples (in both PRE/POST-outbreak studies) were performed concerning their EP-score and

their socio-demographic characteristics. The power of both basic and adjusted matching models was calculated using PASS 13-NCSS program [174,175].

RESULTS

A total of 154 female Extended-AEGYPTI residents have answered the complete questionnaire. All of them were scored according to the perceptions demonstrated (for EP-Score calculation) and marked according to the six socio-demographic characteristics (for the matching process). A total of 88 pairs were matched, each of them composed by an individual from the PRE-outbreak study and an individual from the POST-outbreak study with equivalent personal-socio-demographic characteristics. Exclusively nine individuals out of those surveyed had dengue, out of those seven were paired. The personal-socio-demographic feature of the studied populations is described in Table III.1.2.

TABLE III.1.2: DESCRIPTION OF THE SOCIO-DEMOGRAPHIC FEATURE OF TOTAL AND PAIRED SAMPLES IN BOTH STUDIES

Since paired sample from both studies were equivalent in these six variables their socio-demographic characteristics are equal (presented as 'Paired sample'). In what concerns the Age groups some pairs are not homogeneous (labelled with an *), due to the adjustment done in in the Matching process (see Methods' section). In these cases No. of pairs are described by the following order: PRE-outbreak study / POST-outbreak study

	Total Sample PRE-out. study (n=1145) ǂ	Total Sample POST-out. study (n=154)	Paired Sample• (No. of pairs =88)
Gender			
Female	466 (40.7%)	154 (100%)	88 (100%)
Male	679 (59.3%)	-	-
Education level (years)			
Never studied (0)	69 (6.0%)	44 (28.6%)	14 (15.9%)
Fourth Grade (4)	438 (38.3%)	31 (20.1%)	24 (27.3%)
Ninth Grade (9)	254 (22.2%)	30 (19.5%)	16 (18.2%)
High School (12)	204 (17.8%)	43 (27.9%)	28 (31.8%)
Upper Education (+12)	180 (15.7%)	6 (3.9%)	6 (6.8%)
Age groups (years)			
25 or younger	152 (13.3%)	7 (4.5%)	3 (3.4%) / 5 (5.7%)*
26-35	157 (13.7%)	19 (12.3%)	9 (10.2%) / 7 (8.0%)*
36-45	186 (16.2%)	24 (15.6%)	14 (15.9%) / 14 (15.9%)
46-55	198 (17.3%)	40 (26.0%)	18 (20.5%) / 21 (23.9%)*
56-65	170 (14.8%)	36 (23.4%)	21 (23.9%) / 21 (23.9%)
66-75	160 (14.0%)	21 (13.6%)	17 (19.3%) / 13 (14.8%)*
76 or older	122 (10.7%)	7 (4.5%)	6 (6.8%) / 7 (8.0%)
Municipal Division			
Funchal	666 (58.2%)	154 (100.0%)	88 (100.0%)
Câmara de Lobos	479 (41.8%)	-	-
Travelled to DEC[1]			
yes	863 (75.4%)	89 (57.8%)	60 (68.2%)
no	282 (24.6%)	65 (42.2%)	28 (31.8%)
Admitted MQ exposure (AME)[2]			
yes	286 (25.0%)	46 (29.9%)	20 (22.7%)
No	859 (75.0%)	108 (70.1%)	68 (77.3%)

[1] Distinguish those that have/not travelled to dengue endemic countries (at least once)

[2] Reflects those who admitted/not to had been bitten by mosquitoes

ǂ Individuals that were scored regarding the 13 questions for perception assessment and that also have answered to the personal-socio-demographic data and thus were punctuated for the matching process

• Adjusted matching

* Differences resulted from the adjustment done in in this Matching process

ESSENTIAL-PERCEPTION ANALYSIS

Score of Essential Perception (EP-score)

Figure III.1.1 represents the EP-score distribution of four samples: PRE-outbreak study's total subjects (n=1145), PRE- outbreak study's paired subjects (n=88), POST-outbreak study's total subjects (n=154) and POST-outbreak study's paired subjects (n=88). Comparing the paired subjects it is clear that the paired sample from the POST-outbreak study had generally achieved higher levels of EP-Score than the paired sample from the PRE-outbreak study.

FIGURE III.1.1: PERCENTAGE OF RESIDENTS THAT ACHIEVED EACH LEVEL OF THE EP-SCORE WITHIN THE FOUR POPULATIONS: TOTAL AND PAIRED IN BOTH PRE-OUTBREAK AND POST-OUTBREAK STUDIES
(nTotal of each analysed population is mentioned on respective subtitle)

Figure III.1.1 a) Comparison of EP-score distribution between paired samples from both PRE/POST-outbreak studies

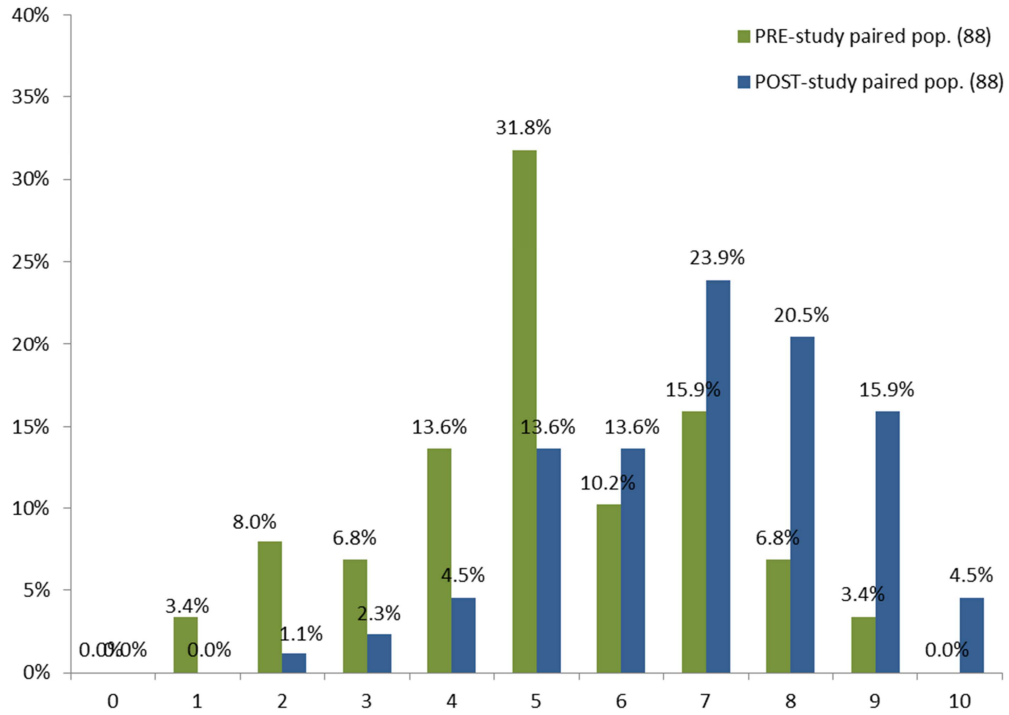


Figure III.1.1 b) Comparison of EP-score distribution between total and paired samples from PRE-outbreak study

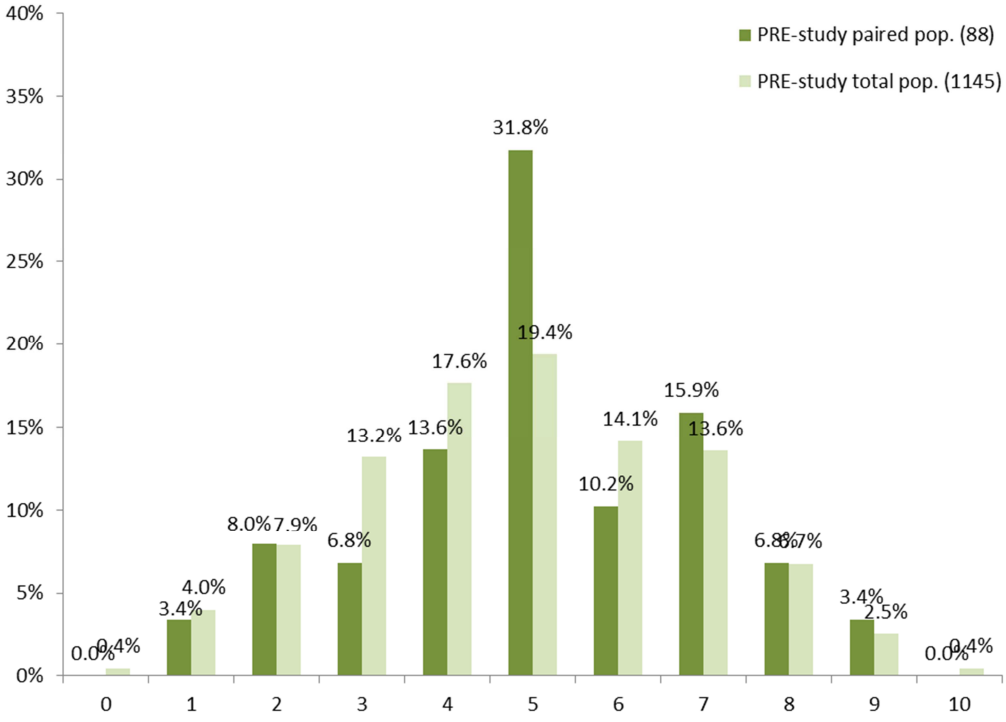
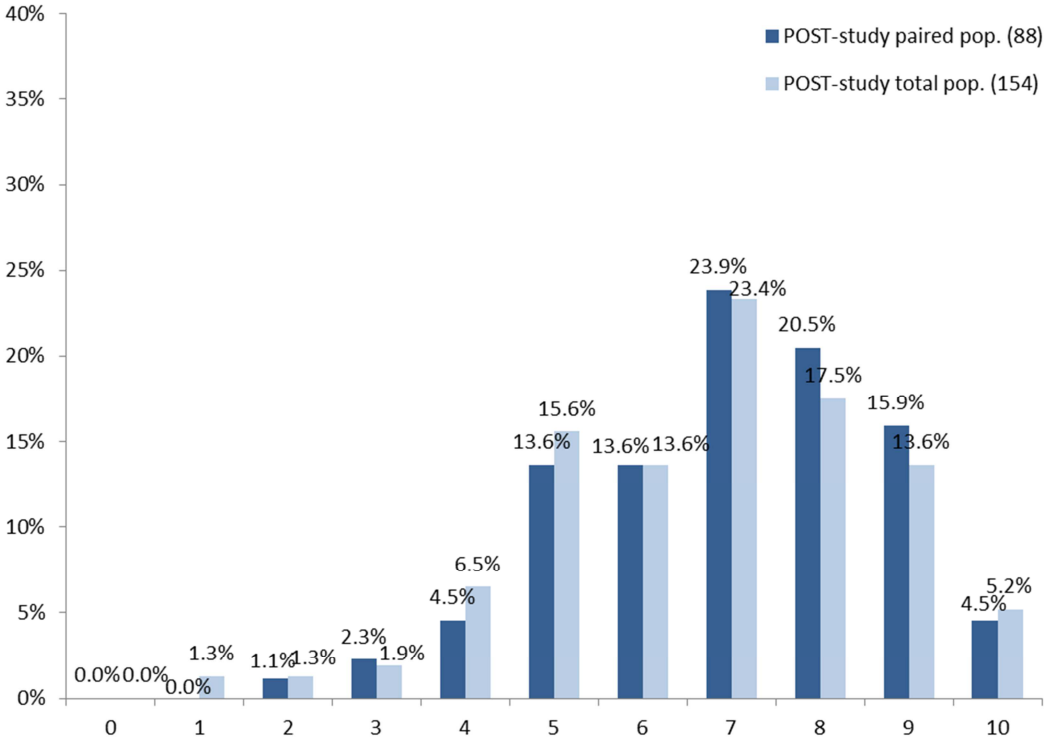


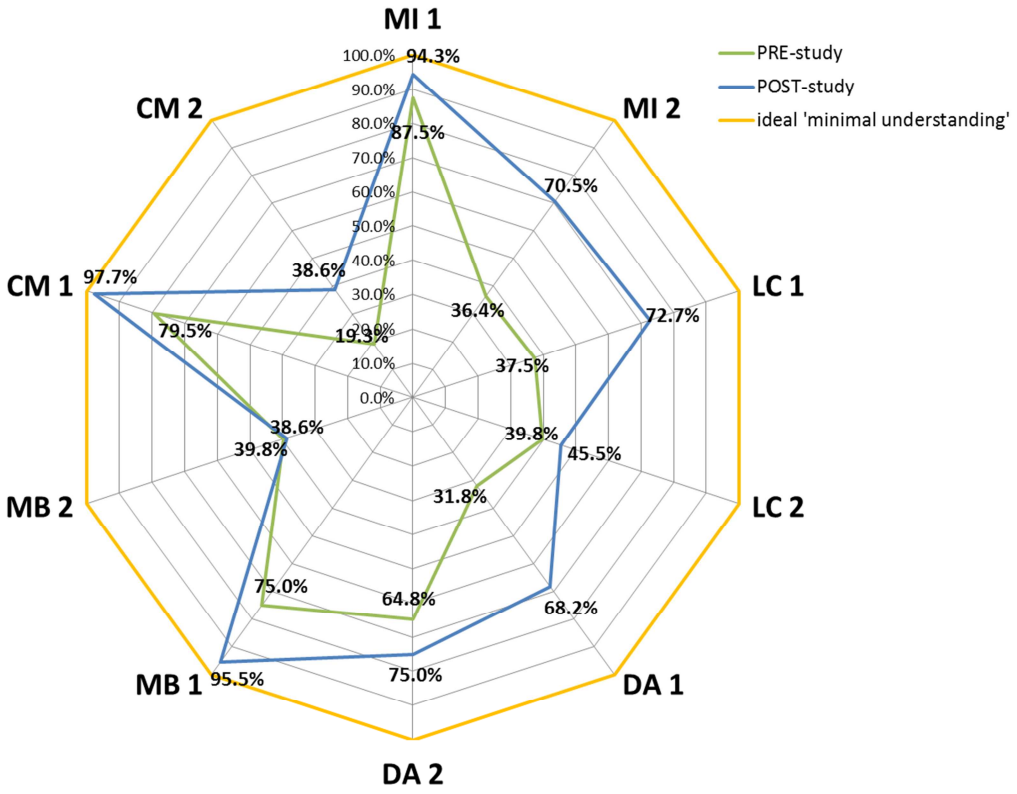
Figure III.1.1 c) Comparison of EP-score distribution between total and paired samples from POST-outbreak study



Concept assimilation

When comparing the observed concept assimilation in both studies, the POST-outbreak study has generally more individuals who assimilate each of the essential concepts (Figure III.1.2). The percentage of female residents considering 'the existence of mosquito-borne diseases' (MI2-concept), 'the presence of vector species in their residential area' (LC1-concept) and that 'mosquitoes can breed inside houses' (DA1-concept) have almost doubled, from 36.4% to 70.5%, from 37.5% to 72.7% and from 31.8% to 68.2% respectively. Regarding the remaining essential concepts, these generally also increased after the outbreak in terms of the percentage of individuals that have acknowledged them, with the exception of the MB2-concept that slightly decreased. Overall, following the experience of a dengue outbreak, almost all the respondents (95.5%, 96.6% and 97.7%) believed that 'mosquitoes can transmit diseases' (MI1-concept), recognized 'water as a mosquito breeding inducers' (MB1-concept) and referred to 'the reduction of breeding sites as being a (fairly/very/extremely) effective measure in the control of mosquitoes' (CM1-concept). In contrast to, there were some essential concepts which remained unknown for the majority of the studied individuals. These were the 'Local Risk 2', 'Mosquito Breeding 2' and 'Control Measures 2' which are also the less acknowledged essential concepts. In fact, only 45.5% believed that 'there is a high possibility for dengue (re-)emergence in Madeira' (LC2-concept), merely 38.5% correctly admitted to the 'false role of pets and food debris in the mosquito breeding' (MB2-concept) and only 38.6% did not identify 'the use of a flyswatter or indoor insecticide spraying, as effective for *aegypti*-control' (CM2-concept).

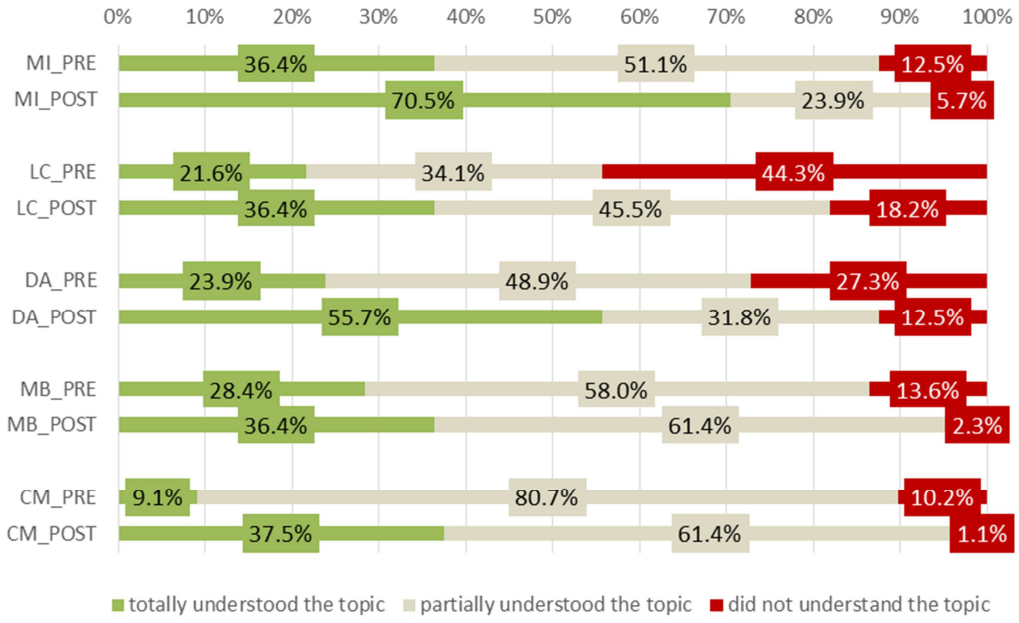
FIGURE III.1.2: PROPORTION OF FEMALE RESIDENTS WHO HAVE 'ASSIMILATED' EACH OF THE TEN ESSENTIAL CONCEPTS IN BOTH PRE-OUTBREAK AND POST-OUTBREAK STUDIES.
For Figure simplification, essential concepts were abbreviated to their name initials: Medical Importance 1 and 2 (MI 1and 2), Local Risk 1 and 2 (LC 1and 2), Domestic Attribute 1and 2 (DA 1and 2), Mosquito Breeding 1and 2 (MB 1and 2), Control Measures 1and 2 (CM 1and 2).



Topic Understanding

Topic understanding clearly improved after the outbreak (Figure III.1.3). In general, the percentage of those who had totally understood each topic increased, and the percentage of those who had not completely understood each of them, decreased. 'Medical Importance' and 'Domestic Attribute' topics became completely understood by the majority of the female Extended-AEGYPTI residents (70.5% and 55.7%). Even after the noticeable increase of people that had totally understood the topics 'Local Risk', 'Mosquito Breeding' and 'Control Measures', the majority of the studied residents still did not understand, or only partially understood them. Similar to the PRE-outbreak study, the 'Local Risk' topic in the POST-outbreak study had the highest proportion of respondents who disregarded both topic-related concepts (Figure III.1.3).

FIGURE III.1.3: PERCENTAGE OF RESIDENTS THAT HAVE 'UNDERSTOOD', 'PARTIALLY UNDERSTOOD' OR 'NOT UNDERSTOOD' EACH OF THE FIVE STUDIED TOPICS.
For Figure simplification, topics were abbreviated to their name initials: Medical Importance (MI), Local Risk (LC), Domestic Attribute (DA), Mosquito Breeding (MB), Control Measures (CM). 'PRE' and 'POST' represents PRE-outbreak study and POST-outbreak study.



Myth identification and estimation

Based on the thirteen myths/beliefs that were identified in the PRE-outbreak study, an updated list is suggested in Table III.1.3, with myths identified after the outbreak. The frequency of each believed myth were (re-)calculated in Additional file III.1.6 and are also presented in Table III.1.3. Out of the thirteen alleged myths identified in the PRE-outbreak study, some had most likely disappeared after the outbreak. This was what happened with the myths: «dengue is not a mosquito-borne disease» or «dengue only occur in tropical/non-developed countries» (Table III.1.3). However, new beliefs emerged after the end of the outbreak, such as the idea that Madeira is protected from a second dengue outbreak (alleged myths 3 and 4). This is suggested to be believed by the majority of the female community (54.6%). According to the myth analysis, after the outbreak each female resident believed, on average, in three out of the twelve myths, less than the four myths out of thirteen believed by the average of the residents before the outbreak. Most of them believed at

least in one myth either before or after the outbreak (99.5% and 95.5%, respectively). After the outbreak, the most disseminated alleged myth, found in 62.5% of the paired sample, was that «clean houses or houses without animals do not have mosquitoes» or «people living in these houses have nothing to do concerning the control of mosquitoes».

TABLE III.1.3: ALLEGED MYTHS IN BOTH PRE AND POST STUDIES AND RESPECTIVE FREQUENCIES
Myths derived from PRE-outbreak study were renumbered

			PRE-OUTBREAK STUDY	POST-OUTBREAK STUDY	DIFFERENCE
ESSENTIAL TOPICS	~~Old~~ / New No.	**ALLEGED MYTHS**	n (%)	n (%)	
MEDICAL IMPORTANCE	MYTH 1	'Mosquitoes do not transmit diseases'	11 (12.5)	5 (5.7)	↓
	MYTH 2	'Mosquitoes only cause mild clinical consequences such as allergies, fever, etc.'	45 (51.1)	21 (23.9)	↓↓
LOCAL RISK	~~MYTHS 3 AND 4~~	'Dengue is not a mosquito-borne disease' and/or "Dengue only occur in tropical/non-developed countries"	14 (15.9)		(disappeared)
	MYTH 3	'Dengue will not occur again in Madeira, it is very not likely'		32 (36.4)	(new)
	~~MYTHS 5 AND 6~~ / MYTHS 4 AND 5	(i) 'Since I do not feel the byte, I am not at risk of being bitten/infected'; (ii) "Mosquitoes are allocated in a specific area and are not able to spread through my municipality'	16 (18.2)	8 (9.1)	↓
	~~MYTH 7~~	'Madeira's residents are not at risk'	39 (44.3)		(disappeared)
	MYTH 6	'Dengue/*A. aegypti* was, finally, eradicated'		16 (18.2)	(new)
DOMESTIC ATTRIBUTE	MYTH 7 ~~(MYTH 8)~~	'Local health authorities are the key intervenient in the control of mosquitoes'	7 (8.0)	11 (12.5)	↑
	MYTH 8* ~~(MYTH 9)~~	'Insecticides or other protective measures can control mosquitoes'	36 (40.9)*	17 (19.3)*	↓↓
	MYTH 9 ~~(MYTH 10)~~	'I am (Community is) not an intervenient in the *aegypti*-control'	24 (27.3)	11 (12.5)	↓↓↓
MOSQUITO BREEDING	MYTHS 10 AND 11 ~~(MYTHS 11 AND 12)~~	'Clean houses or houses without animals do not have mosquitoes' and/or 'Clean people have nothing to do concerning the control of mosquitoes'	53 (60.2)	54 (61.4)	=
CONTROL MEASURES	MYTH 12* ~~(MYTH 13)~~	'By the usage of insecticides and/or flyswatter, I am already contributing to the *aegypti*-control'	71 (80.7)*	54 (61.4)*	↓

Myths 8 and 12 cover the same idea and if added, reveal a total of 67.0 % of the residents feeling that by the usage of protective measures, they are already contributing to the *aegypti*-control.

(↑) Differences of 5-20 percentage points
(↑↑) Differences of 20-30 percentage points
(↑↑↑) Differences of more than 30 percentage points
(=) Differences of less than 5 percentage points

STATISTICAL ANALYSIS (TEST STATISTICS)

Statistical tests were performed in order to explore the differences between medians of populations from both PRE/POST-outbreak studies,

confirming a significant increase in the EP-Score median of the POST-study population (p<0.001, Table III.1.4).

TABLE III.1.4: EP-SCORES FROM TOTAL AND PAIRED SAMPLES OF BOTH PRE/POST-OUTBREAK SURVEYS AND ASSOCIATIONS BETWEEN THEM

	n Total ǂ (matching compatible)	**EP-Score medians (P_{25}-P_{75}) +**	**n Paired**	**EP-Score medians (P_{25}-P_{75}) +**	***p* value**
PRE-outbreak survey	1145•	5.0 (3.0 – 6.0)	88	5.0 (4.0 – 7.0)	0.245′
				↕	
POST-outbreak survey	154	7.0 (5.0 – 8.0)	88	7.0 (6.0 – 8.0)	0.350′
			***p* value**	<0.001*	

+ Weighted Average method; * Wilcoxon test ; ′ Mann-Whitney test;

ǂ number of individuals compatible for matching. *i.e.* individuals who were scored regarding the 13 questions for perception assessment and who also have answered to the socio-demographic data and thus were punctuated for the matching process.

• Out of the 1182 individuals that were scored in the PRE-study, 37 subjects were not included in the matching process, since they lack critical socio-demographic data;

An increase of the number of individuals who achieved an EP-score equal to or higher than seven (EP-score≥7) in the POST-study population, was also statistically confirmed (p<0.001, Table III.1.5).

TABLE III.1.5: EVOLUTION OF THE SIZE OF THE RESIDENTS' GROUPS BEFORE AND AFTER THE OUTBREAK ACCORDING TO THE CUT-OFF: EP-SCORE ≥ 7

		POST-outbreak survey (paired population)		***p* value**
		EP-Score < 7	**EP-Score ≥7**	
PRE-outbreak survey (paired population)	**EP-Score < 7**	27 (=)	38 (↑)	<0.001+
	EP-Score ≥ 7	4 (↓)	19 (=)	

nTOTAL=88 pairs

(=) Number of individuals that did not change the EP-Score level compared with its pair

(↓) Number of individuals that have increased the EP-Score level compared with its pair

(↑) Number of individuals that have decreased the EP-Score level compared with its pair

+ McNemar test

Confirming validity of the 'Matching Process'

The validity of the model used in the matching process was also statistically established. As shown in Table III.1.3 the difference between the EP-score from the total and paired populations (in both PRE/POST-outbreak studies) did not change significantly ($p>0.05$ in both cases). In what concerns the personal-socio-demographic feature, total and paired populations also did not differ expressively. Slight differences are detected in proportions of age groups and in high education levels (Figure III.1.4).

FIGURE III.1.4: COMPARISON OF PERSONAL-SOCIO-DEMOGRAPHIC DATA BETWEEN PRE/POST-OUTBREAK SURVEY POPULATION (TOTAL AND PAIRED)

Age group, Education level, Travels to DEC, and AME (bitten by mosquitoes) variables are presented. Since Gender and Municipal Division are fixed within matching pairs (only female Funchal residents are matched) these variables are not presented in these Figures.

Figure III.1.4 a) – Data from Total Sample of the PRE-outbreak study

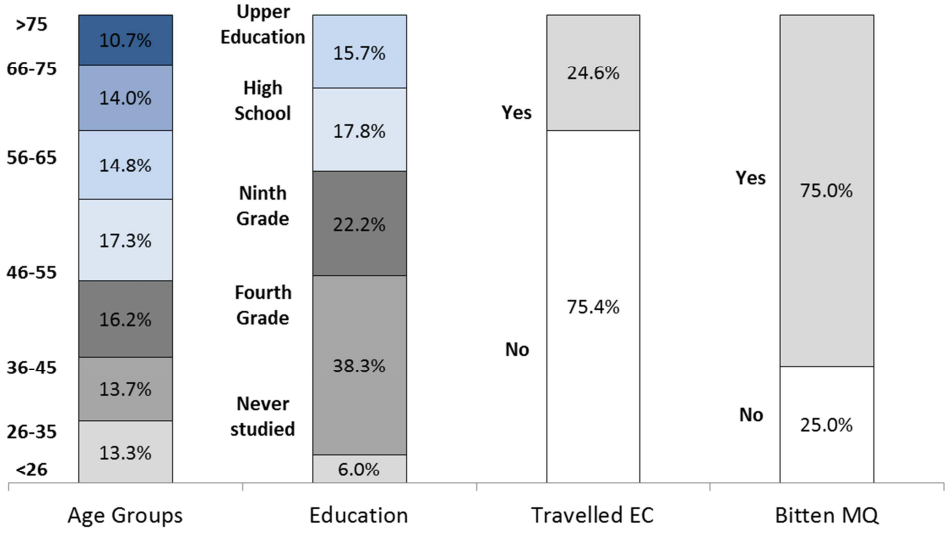


Figure III.1.4 b) – Data from Total Sample of the POST-outbreak study

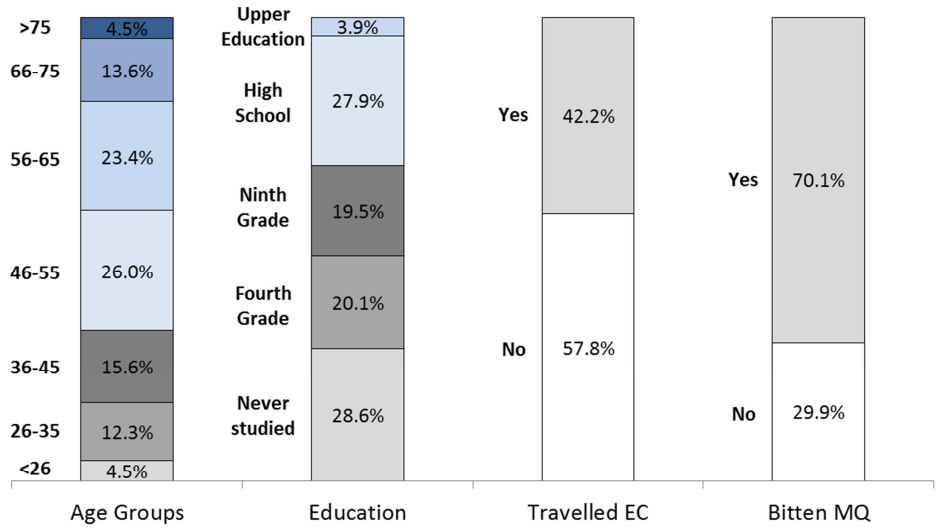


Figure III.1.4 c) – Data from Total Paired of the PRE-outbreak study

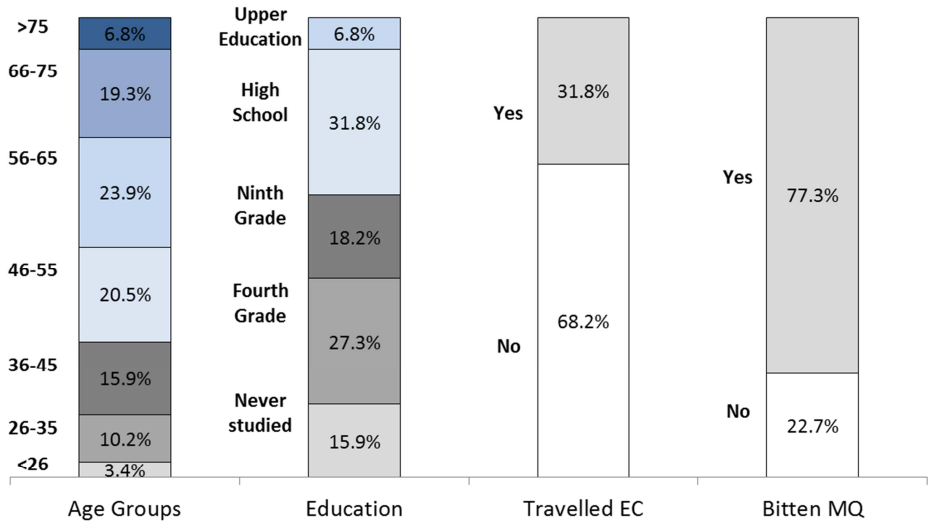
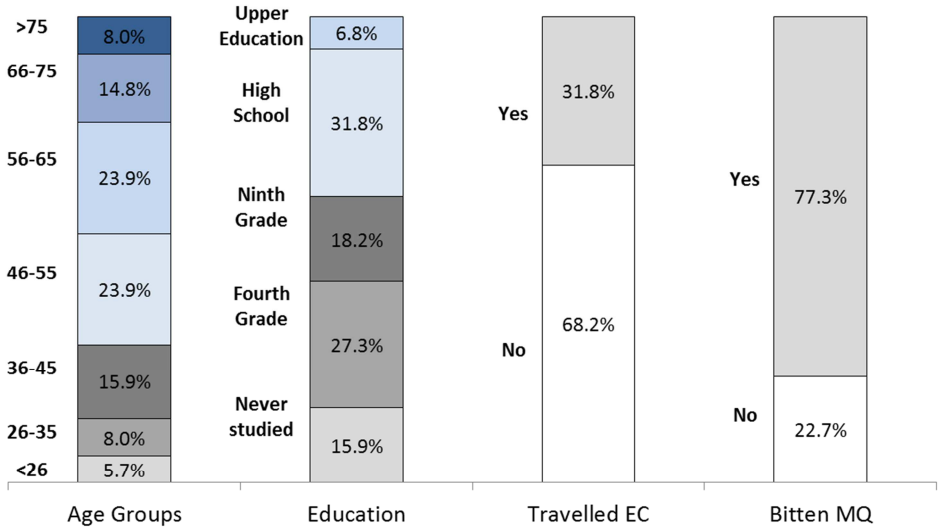


Figure III.1.4 d) – Data from Total Paired of the POST-outbreak study



Comparison between basic and adjusted matching models

The basic matching resulted in 65 pairs of individuals with equivalent personal-socio-demographic characteristics, being the pairs derived from individuals of each of the PRE/POST-outbreaks studies performed. The assessed differences in the perception of those surveyed before and after the outbreak, were equivalent to the previously described, obtained from the comparison of perception of the pairs derived from the adjusted matching. In fact not only the distribution and mean of the EP-score, but

also the concept assimilation and even the topic understanding observed for the 65 pairs selected by the basic matching, were approximately the same that the ones measured for the 88 pairs resulted from the adjusted matching. Moreover, and as observed within the pairs derived from the adjusted matching, in the pairs derived from basic matching the POST-outbreak EP-score median has also significantly increased when compared to the PRE-outbreak one ($p<0.001$). Additionally, a significant increase of the number of individuals that achieved an EP-score equal to or higher than seven (EP-score≥7) in the POST-study paired population, was also observed when looking at pairs derived from the basic matching ($p<0.001$). Table III.1.6 summarizes the main results obtained from both matchings, including the power values which were equal in both cases.

TABLE III.1.6: COMPARISON BETWEEN BASIC AND ADJUSTED MATCHING CRITERIA AND RESULTS

	Basic Matching	**Adjusted Matching**
	ten-year 'age group'	twenty-year 'age group'
Criteria*	'Municipalities' in the same county represent different demographic group	'Municipalities' in the same county represent the same demographic group ('Municipal Division')
n of individuals in the POST Total sample (matching compatible)**	93	154
No. of pairs PRE/POST (POST Paired sample)	65	88
Differences in EP-score medians and percentiles (POST-PRE)	2.0 (7.0-5.0)	2.0 (7.0-5.0)
Power of the Wilcoxon test (used in the comparison between POST/ PRE EP- Score median)	~1.000	~1.000

* No significant differences observed (Additional file III.1.5)
** Individuals that were scored regarding the 13 questions for perception assessment and that also have answered to the socio-demographic data and thus were punctuated for the matching process.

DISCUSSION

In general, the community perception regarding preventive domestic practices increased within female residents of most *aegypti*-infested areas in Madeira Island after they experienced a dengue outbreak. By analysing how and how much assimilation of each 'Essential-concept' has changed, crucial information can be retrieved regarding people´s perceptions about this experience and their future role in its prevention.

For many Madeira residents, the experience of a dengue outbreak, the first in almost a hundred years in Europe, was probably the first contact with a mosquito borne disease [172]. This can explain the increase in the

assimilation of the idea that 'mosquitoes can transmit diseases' (MI1-concept). Moreover, before experiencing the outbreak, the community's worst incident with mosquitoes was allergic reactions, which could be considered as the sole health consequence of mosquito bites. After the outbreak, it was not surprising that the percentage of residents that were aware of 'the kind of diseases that mosquitoes can transmit (such as dengue, yellow fever and malaria)' (MI2-concept) almost doubled. Therefore, in the POST-outbreak study there were a higher percentage of people who rightly appraised the impact of mosquitoes in health. Since no fatal cases occurred during the dengue outbreak, some beliefs such as, 'dengue disease does not kill' and 'dengue in Madeira is less aggressive' may be present in the community. These questions should be considered in the case that a different virus serotype reaches the Madeira territory, increasing the risk of dengue haemorrhagic cases.

Even though assimilation of both 'Local Risk' concepts increased after the outbreak, the majority of residents still ignored that 'there is a high possibility for a (second) dengue outbreak in Madeira' (LC2-concept). The acknowledgement of this concept was expected to increase after the outbreak, assuming that the previous identified myth which states that 'Madeira were not at risk of have dengue' would be opposed with the experience of a dengue outbreak. However, its assimilation merely increased 5%. Even though people had probably realized that Madeira was at risk and that several dengue cases occurred, two erroneous interpretations could explain this 5% result. Firstly, the false belief that the 'dengue outbreak have ended due to the eradication of the disease or the mosquito' (alleged myth 6, Table III.1.3). Secondly, the invalid belief that when something happens more frequently than normal during a period of time, the probability of happening again in the future decreases (gambler's fallacy) (alleged myth 3, Table III.1.3) [163]. People who believe in these alleged myths underestimate the probability of another dengue epidemics occur in Madeira Island.

Improvements in DA1-concept, DA2-concept, LC1-concept and MB1-concept can be attributed to the "boom" of educational information

transmitted during the outbreak. This information was transmitted by the news, by official reports, and most importantly by the exhaustive door-to-door campaign that was rapidly implemented in the areas where most dengue cases were reported. In the latter, trained personnel of the health-authorities entered in residential buildings and supported the residents in performing correct and extensive elimination of mosquito breeding sites inside and in the surroundings of their houses (*i.e. aegypti* source reduction). This provided a useful opportunity for residents to realize 'the existence of larval forms/mosquitoes in their own houses' (DA1-concept), to 'recognize containers that were serving as breeding sites' (MB1-concept), to emphasize the idea that 'domestic control could be efficient in the *A. aegypti* control' (DA2-concept), and finally to comprehend that their 'residential area had (indeed) vector-mosquitoes' (LC1-concept).

In contrast with the improvement in the above concepts, the percentage of people that believed in 'false mosquito breeding inducers, such as, animals or food debris' augmented after the outbreak and thus, MB2-concept was the sole concept of which assimilation had declined after the outbreak. Female residents may have 'erroneously indorsed *A. aegypti*'s proliferation to dirty environments' (with food debris or animals). This assumption could be interpreted as an intuitive trial to explain the appearance/establishment of the *A. aegypti* and dengue disease in the Island. As stated in psychology in the attribution theory, humans need to "attribute" causes to events which are not understood [30]. Female residents, who agreed with latter belief, and do not have animals or believe to live in clean households, will not feel responsible to perform domestic source reduction.

Finally, almost all the female residents agreed with the efficacy of domestic source reduction in the control of mosquitoes (CM1-concept). However, the majority still erroneously considers 'insecticide application or flyswatter usage' as effective measures to control mosquito population (CM2-concept). In fact, these practices are protective (*i.e.* can, in some manner, avoid the mosquito bite) but are not preventive (*i.e.* are able to control the mosquito proliferation). This mistake is determinant because people that

believe in it tend to focus their efforts on these easier but less efficient practices and to disfavour the truly efficient ones, which are more difficult to implement (such as, domestic source reduction). Moreover, previous studies have shown that the local *A. aegypti* population, present in Madeira Island, is resistant to the most common insecticides, which raises questions regarding the reasonability of its application, even when used with protective objectives [31].

Overall, there are only three Essential Concepts that are still not considered by the majority of the studied population (LC2-concept, MB2-concept and CM2-concept). Under the assumptions of the EP-analysis, the individual minimal understanding and putative subsequent accession of the proposed behaviour, requires the assimilation of all the ten concepts defined as 'essential'. Consequently, the weak integration of one of these concepts by the community can compromise the usefulness of the behaviour impact campaigns. It is worth pointing out that, even though concept assimilation had generally improved after the outbreak, only 4.5% of the studied population achieved the referred 'minimal understanding' (EP-Score equal to ten). Consequently, there were still very few residents that are ready to engage in the proposed behaviour.

Along with the observed improvement of essential concept assimilation, myths believed by the community also changed. Even though the community is now closer to the needed 'minimal understanding', the task of local authorities is still difficult since now they have to cope with new/different beliefs. After the outbreak, following ideas such as 'Madeira is immune to suffer a second outbreak' (alleged myth 3 and 6) and 'by the usage of insecticides and/or flyswatter, I am already contributing to the *aegypti*-control' (alleged myth 12) appear to be massively spread within the community. The latter together with its similar alleged myth 8, totalized 67.0% of the residents that are not aware of the effective control measures and, thus, they do not understand how the domestic *aegypti*-control should be done.

In reality, myths can subtly persist in the community weakening the behaviour impact strategies. Therefore, an adequate monitoring of public

perceptions is undoubtedly crucial to (more quickly) detect them and allowing preventive campaigns to be planned accordingly. Moreover, the public perceptions can result in strongly valuables public-government partnerships also providing other important information far beyond the detection of community erroneous perceptions [81,118,155,177]. Apart from the here observed public erroneous interpretations (probably caused by their short contact with the vector and the disease) community can provide other enriching contribution such as technical hitches in implementing proposed behaviours, pointing out messages or expressions difficult to understand, suggesting housewives-friendly solutions.

The similarity found between total and paired populations regarding their EP-score levels and personal-socio-demographic features, confirmed the validity of the criteria used in the matching process model. Moreover, the observed equivalence between the adjusted and the basic matchings corroborated the validity of the applied adjustments. Furthermore, the calculated power value supported the strength of the results although the apparently small size of the sample.

In fact, prior sample size estimations indicated a minimal amount of 157 subjects required to fulfil the objectives of this study (as mentioned in Methods section), assuming a minimal difference (1 point) between the EP-score levels from PRE/POST-outbreak studies. However, since a difference of 2 point was observed, only 40 pairs of subjects were needed to detect it fulfilling the same objectives (Additional file III.1.4 b)) [22]. The studied sample size was higher than the required to the aimed analysis, and therefore, as described in Table III.1.X the power associated to Wilcoxon test is naturally high.

In conclusion, after experiencing a dengue outbreak in Madeira Island, community perception towards the aimed preventive engagement was increased in some aspects (as intuitively expected) but also deviated in other aspects, particularly by the emergence of new myths. The most frequent myths may be used in the future to outline appropriate priority messages. Resulting tailored messages can strengthen community engagement in preventive behaviours. Monitor public perceptions

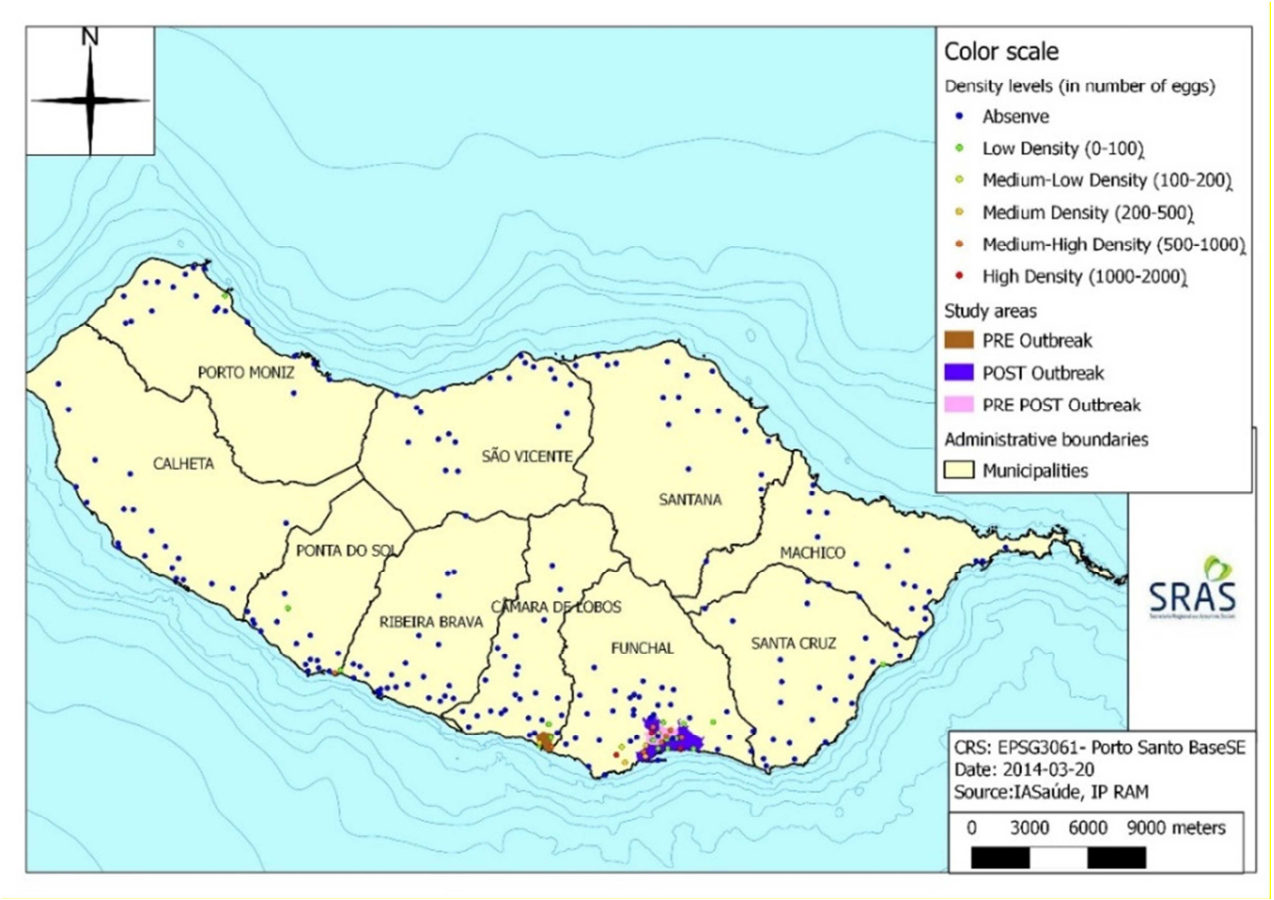
(before/after an intervention or an outbreak) may have a great value not only for public health professionals but also for researchers interested in dissecting the complex interplay between experiences, perceptions and decision-making.

ACKNOWLEDGMENTS

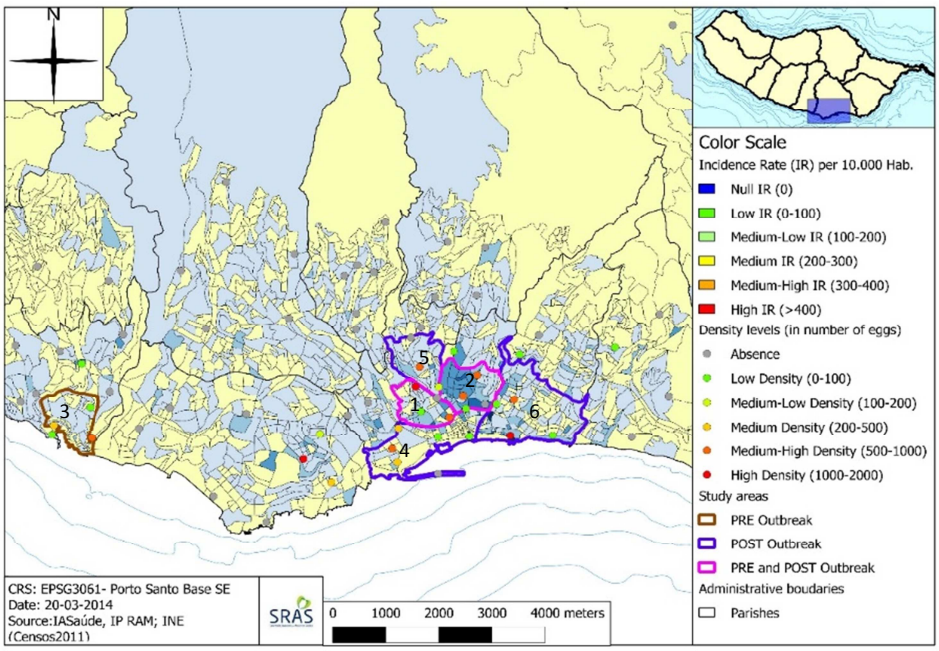
We thank to local community for the great acceptance and its cooperation regarding this work, to Luís Xavier for the guidance in the development of such a complex model required to the analysis performed, and to Fundação para a Ciência e Tecnologia (FCT) for funding this work (references: PTDC/SAL-EPI/115853/2009 and SFRH/BD/51012/2010).

ADDITIONAL DATA

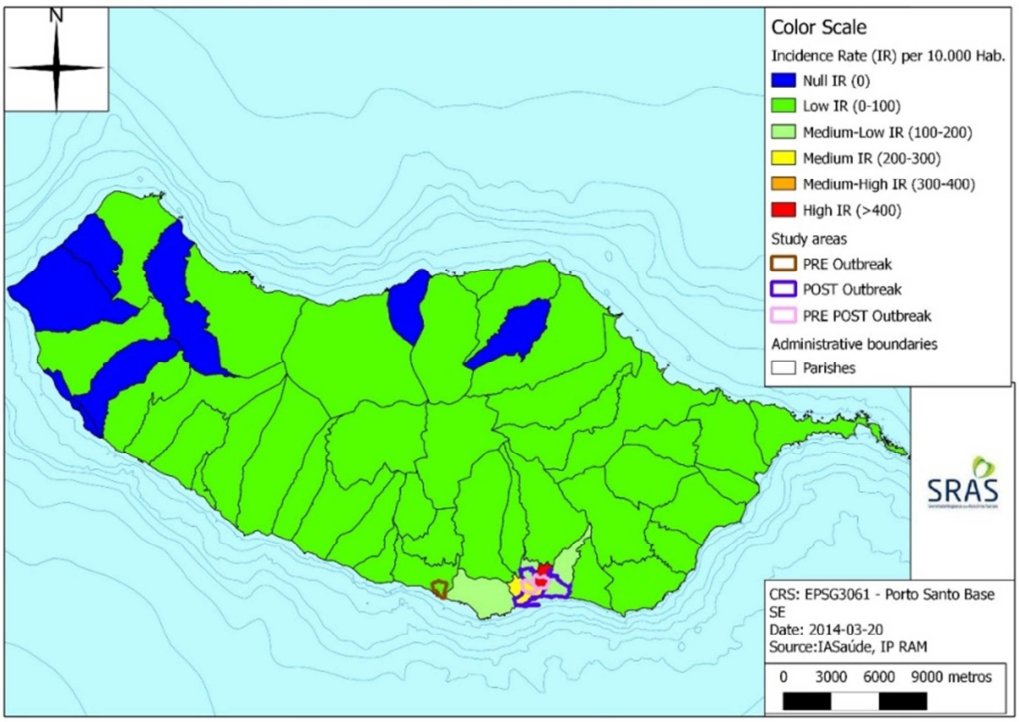
Additional File III.1.1a) - *Aedes aegypti*'s distribution in Madeira island (2011) resulted from the Island-wide transversal entomological survey using ovitraps. Study areas of both PRE-outbreak and POST-outbreak studies are also described. Administrative boundaries described are relative to Island Counties ('Municipal divison'), and not to Municipalities as stated in the Color scale.



Additional File III.1.1b) Description of the areas included in PRE-outbreak and POST-outbreak studies, detail of the previous map focusing the most *aegypti*-infested. Administrative boundaries described are relative to parishes (or 'Municiplities'). Numbers represent the part of each municipality covered in the studies areas.[16]

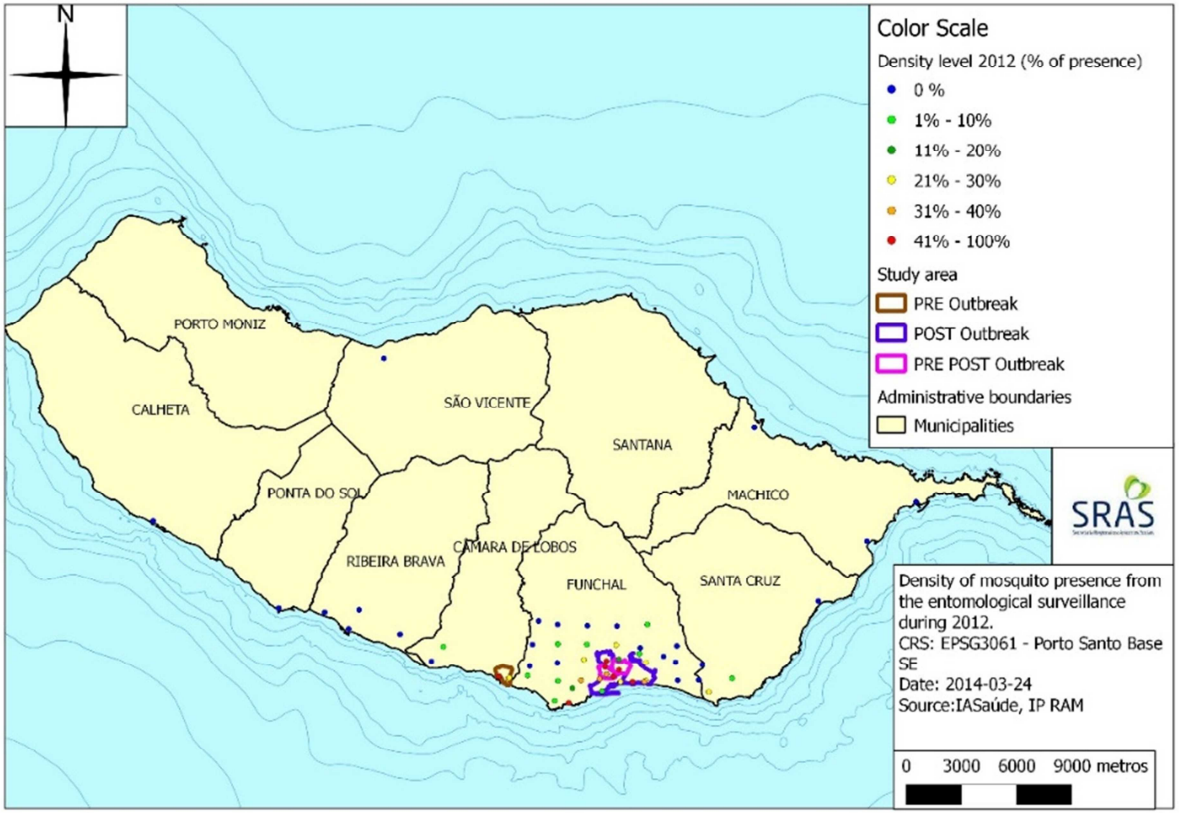


Additional File III.1.1 c) - Incidence rate of the 2012 dengue outbreak (probable dengue cases per 10.000 residents). Administrative boundaries described as «Parishes» refer to what in the text is considered «Municiplities»



[16] 1- São Pedro; 2- Santa Luzia; 3- Câmara de Lobos; 4- Sé; 5- Imaculado Coração e Maria; 6- Santa Maria Maior

Additional File III.1.1 d) – *Aedes aegypti*'s distribution in Madeira Island (2012) – resulted from an Island-wide longitudinal entomological survey using ovitraps performed from tenth week of 2012 (end of February) until ninth week of 2013 (end of February)[17]. Due to their different type of surveys and ovitraps position it cannot be directly compared with its Additional File III.1.1 a). Even though, it reveals an expansion of *A. aegypti*'s mosquito considering the PRE-outbreak study confirming the need to expand it in the POST-oubreak study. Administrative boundaries described as «Municiplities» refer to what in the text is considered «county» or «Municipal Division»



[17] This period represents what local authorites is consider the mosquito's year calendar

Additional File III.1.2: Socio-demographic characterization of Funchal's Municipalities: Santa Luzia (SL), São Pedro (SP), Sé, Imaculado Coração de Maria (ICM) e Santa Maria Maior (SMM). Differences between proportions of those included in the PRE-study (SP and SL, in green) and those that were added in the POST-study (Sé, ICM and SMM in orange) are presented (in grey).

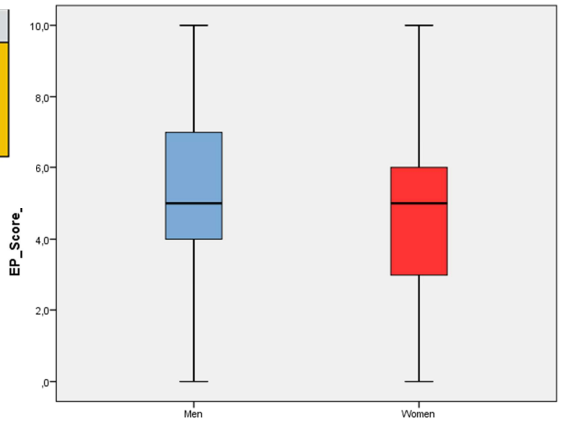
%	Women resident	Women between 15&19 years	Women between 20&24 years	Women between 20&64 years	Women between 25&64 years	Women more than 64 years
SL	55.7	2.5	2.4	31.6	29.2	15.3
SP	55.4	2.4	2.6	32.6	30.0	13.0
SL+SP	**55.6**	**2.5**	**2.5**	**32.0**	**29.5**	**14.5**
Sé	58.2	2.8	2.1	32.5	30.4	16.7
ICM	54.2	5.1	5.2	34.6	31.6	12.4
SMM	54.3	2.5	2.8	31.3	28.4	14.6
Sé+ICM+SMM	**55.1**	**3.2**	**3.3**	**32.4**	**29.6**	**14.4**
Difference	-0.5	0.7	0.8	0.4	0.1	0.0

%	Never studied	4th grade	6th grade	9th grade	12th grade	Post-secondary school	Degree
SL	2.1	20.0	11.2	16.9	17.1	0.9	20.5
SP	3.5	24.6	11.9	16.4	13.5	1.4	15.5
SL+SP	**2.6**	**21.7**	**11.4**	**16.8**	**15.8**	**1.1**	**18.6**
Sé	2.1	17.7	9.5	15.7	15.6	1.0	27.3
ICM	7.3	26.6	15.2	17.7	14.9	3.4	15.4
SMM	3.3	23.6	12.8	16.6	15.6	1.0	16.2
Sé+ICM+SMM	**4.1**	**23.2**	**12.8**	**16.7**	**15.4**	**1.6**	**18.2**
Difference	1.5	1.5	1.3	-0.1	-0.3	0.5	-0.5

Additional File III.1.3: EP-score median differences regarding Gender using Mann-Whitney test (Output from Statistical Package for Social Sciences 19.0)

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of EP_Score_OU_K_total is the same across categories of Genero.	Independent-Samples Mann-Whitney U Test	,000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.



Additional File III.1.4: Sample size estimation for PRE/POST pairs EP-scores comparison (Outputs from EPI-tools results for comparison of means with equal size and variance) [168]

a) **Sample size for detecting a 1-value difference within the PRE/POST pairs EP-score means**

Inputs

Mean 1	5
Mean 2	6
Variance	10
Confidence level	0.95
Power	0.8
Tails	2

Results

	Sample size
Sample size (per group):	157
Total sample size (both groups):	314

b) **Sample size for detecting a 2-value difference within the PRE/POST pairs EP-score means**

Inputs

Mean 1	5
Mean 2	7
Variance	10
Confidence level	0.95
Power	0,8
Tails	2

Results

	Sample size
Sample size (per group):	40
Total sample size (both groups):	80

Additional File III.1.5: Analysis on the basis of the matching process adjustment. Part a) represent the absence of significant differences between Municipalities, if comparing individuals of the same Education level (as happens in the matching). Part b) represents the absence of significant differences between consecutive ten-year age group. Output from S Statistical Package for Social Sciences 19.0 (SPSS, Inc., Chicago, IL, USA)

a) Comparisons of EP-Score medians between 'Municipalities' according to their Education level (results presented in an ascending order from Educational level = 1 to Educational level =5)

b) Comparison of EP-Scores medians between the eight Age groups (black strips represent non-significant differences, yellow strips represent significant differences)

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of KTOTAL is the same across categories of Freguesia.	Independent-Samples Mann-Whitney U Test	,360[1]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1]Exact significance is displayed for this test.

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of KTOTAL is the same across categories of Freguesia.	Independent-Samples Mann-Whitney U Test	,186	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of KTOTAL is the same across categories of Freguesia.	Independent-Samples Mann-Whitney U Test	,824	Retain the null hypothesis.

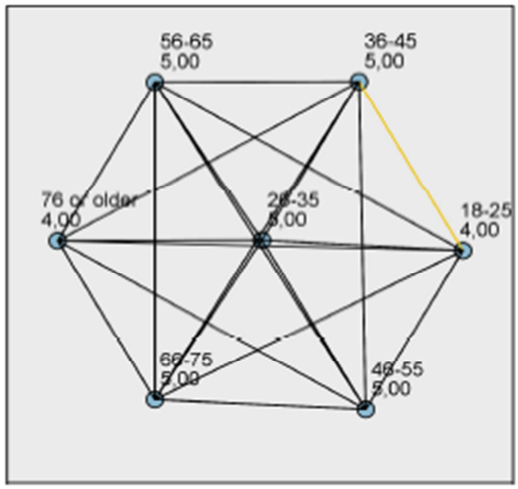
Asymptotic significances are displayed. The significance level is ,05.

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of KTOTAL is the same across categories of Freguesia.	Independent-Samples Mann-Whitney U Test	,178	Retain the null hypothesis.

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of KTOTAL is the same across categories of Freguesia.	Independent-Samples Mann-Whitney U Test	,844	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Pair-wise comparisons	Test statistics	Significance	Adj Sig
1,000-8,000	,774	,379	1,000
1,000-2,000	8,188	,004	,089
1,000-3,000	9,243	,002	,050
1,000-4,000	7,399	,007	,137
1,000-5,000	,632	,427	1,000
1,000-7,000	,920	,338	1,000
8,000-2,000	7,043	,008	,167
8,000-3,000	7,861	,005	,106
8,000-4,000	6,276	,012	,257
8,000-5,000	2,666	,103	1,000
8,000-7,000	,821	,365	1,000
2,000-3,000	,006	,940	1,000
2,000-4,000	,093	,760	1,000
2,000-5,000	3,658	,056	1,000
2,000-7,000	3,857	,050	1,000
3,000-4,000	,160	,689	1,000
3,000-5,000	4,278	,039	,811
3,000-7,000	4,491	,034	,716
4,000-5,000	2,953	,086	1,000
4,000-7,000	3,147	,076	1,000
5,000-7,000	,005	,942	1,000



Additional File III.1.6: Discrepant concepts assimilation analysis POST-outbreak survey

Concepts acknowledgement comparison		Analysis of Topic's Understanding		Community Understanding / Alleged myths
MI1- (concept)	**MI2- (concept)**		**Medical Importance**	
✓	✓	70.5 % (62 ind.)	Residents admitted that mosquitoes transmit diseases such as 'Dengue' (22·5%), 'Malaria' (9·5%), 'Yellow fever' (3·1%) or other mosquito-borne diseases (1·2%) or few of the latters.	Residents seemed to understand the real medical importance of mosquitoes and, thus the relevance of being involved in the *aegypti*-control.
✓	X	23.9 % (21 ind.)	Even though admitting that mosquitoes can transmit diseases, these residents did not know what kind of diseases mosquitoes transmit. Some residents erroneously referred 'allergies' as mosquito-transmitted diseases (6.3%) and 4·5% mentioned other false clinical consequences such us 'SIDA', 'fever' or 'cancer'.	These residents were not aware of the relevance of being involved in the *aegypti*-control. **Alleged Myth 2: "Mosquitoes only cause mild clinical consequences such as allergies, fever, etc."**
X	✓	Not observed		
X	X	5.7 % (5 ind.)	Residents did not know that mosquitoes can transmit diseases	Residents did not understand the medical importance of mosquitoes. Alleged Myth 1: "Mosquitoes do not transmit diseases"
LC1	**LC2***		**Local Context**	
✓	✓	36.4 % (32 ind.)	Residents recognized that there were mosquitoes that transmit diseases in their residential area, and, also, that there was a risk of a dengue outbreak in Madeira.	Residents seemed to understand the local risk they are submitted and, thus the urgency of being involved in the *aegypti*-control.
✓	X	36.4 % (32 ind.)	Residents recognized the presence of mosquitoes that transmit diseases in their residential area; however they believed that a dengue outbreak will not re-emerge in the island. Eventually some residents could think that Madeira is now "protected". Since a dengue outbreak has just occurred, there is a current very low probability of another dengue outbreak to emerge (gambler's fallacy). Other possibility is that some residents could think that the end of the outbreak occurred when the mosquito/disease was eradicated from the island, and thus, now it won't occur anymore.	These residents were not aware of the urgency of being involved in the *aegypti*-control. **Alleged myth 3: "'Dengue will not occur again in Madeira, it is very not likely'";**
X	✓	9.1 % (8 ind.)	Residents did not recognize the presence of mosquitoes that can transmit diseases in their residential area; but admitted that a dengue outbreak can emerge in the island. These residents did not have a correct notion of the *aegypti's* distribution area.	Residents did not understand the risk they are subjected to and neither the urgency of being involved in the *aegypti*-control. **Alleged myths 4 and 5: (i) -"Since I do not feel the byte, I am not at risk of being bitten/infected". ~~(ii) –~~ "Mosquitoes are allocated in a specific area and are not able to spread to my municipality";**
X	X	18.2 % (16 ind.)	Residents did not recognize mosquitoes that transmit diseases in their residential area neither the possibility of a dengue outbreak in the island.	Residents did not understand the risk they are subjected to neither the urgency of being involved in the *aegypti*-control. Alleged Myth 6: "Dengue/*A. aegypti* was, finally, eradicated".
DA1	**DA2**	**%**	**Domestic Attribute**	
✓	✓	55.7 % (49 ind.)	Residents know that mosquitoes can breed inside houses and recognized that domestic *aegypti*-control do have impact in the reduction of *aegypti*-population.	Residents seemed to understand the domestic attribute of the *aegypti*-control and, thus why community is the key intervenient in the *aegypti*-control.
✓	X	12.5 % (11 ind.)	Residents know that mosquitoes can breed inside houses but they did not believe that the domestic *aegypti*-control have impact in the reduction of the *aegypti*'s population. They probably believed that other intervenients have much more impact in the reduction of the *aegypti*'s population.	Residents did not understand the domestic attribute of the *aegypti*-control, neither why community is the key intervenient in the *aegypti*-control. **Alleged Myth 7: "Local health authorities are the key intervenient in the control of mosquitoes".**

X	✓	19.3 **%** (17 ind.)	Mosquitoes cannot breed inside houses but domestic *aegypti*-control does have impact in the reduction of *aegypti*-population in the neighborhood. Those respondents believed in their role in domestic *aegypti*-control but did not understood why that control has an impact, probably by avoided them to enter in the house.	Residents did not understand the domestic attribute of the *aegypti*-control, neither why community is the key intervenient in the *aegypti*-control. **Alleged Myth 8: "Other protective measures can control mosquitoes".**
X	X	12.5 **%** (11 ind.)	Residents do not know that mosquitoes can breed inside houses, neither that their involvement have an impact in the control of mosquitoes.	Residents did not understand the domestic attribute of the *aegypti*-control, neither why community is the key intervenient in the *aegypti*-control. Alleged Myth 9: "I am not/Community is not an intervenient in the aegypti-control".
MB1	**MB2**	**%**	**Mosquito Breeding**	
✓	✓	36.4 **%** (32 ind.)	Residents only identified water-containers (and not other false issues) as mosquitoes' breeding inducers.	Residents seemed to understand where do mosquito breed and, thus the need of the *aegypti*-control activities.
✓	X	591 **%** (52 ind.)	Residents identified water-containers but also other false issues (food debris and pets) as mosquitoes' breeding inducers These residents did not comprehend what lead to the breeding of new mosquitoes and, thus did not understand the proposed measures to control them.	Residents seemed to not understand where mosquitoes breed and neither the need of the *aegypti*-control activities. **Alleged Myths 10 and 11: "Clean houses or houses without pets/animals do not have mosquitoes" or "Clean people did not need to be involved in mosquito control".**
X	✓	2.3 % (2 ind.)	Residents did not identify water-containers neither other false issues (food debris and pets) as mosquitoes' breeding inducers. These residents did not know where do mosquitoes breed or believe in other false breeding sites.	Residents seemed to not understand where mosquitoes breed and neither the need of the *aegypti*-control activities.
X	X	2.3 % (2 ind.)	Residents did not identify water-containers but did identify other false issues (food debris and pets) as mosquitoes' breeding inducers	Residents are completely mistaken regarding mosquitoes breeding and, thus did not understand the need of the *aegypti*-control activities. Alleged Myths 10 and 11: "Clean houses or houses without pets/animals do not have mosquitoes" or "Clean people did not need to be involved in mosquito control".
CM1	**CM2**	**%**	**Control Measures**	
✓	✓	37.5 % (33 ind.)	Residents only recognized water-containers removal (and not other false measures) as "effective to control mosquitoes"	Residents seemed to recognize effective control measures and, thus understand how the domestic *aegypti*-control should be done.
✓	X	60·2 % (53 ind.)	Residents recognized water-containers removal and also other false measures (such as insecticide indoor application and flyswatter use) as "effective to control mosquitoes"	Residents seemed to not be focused on effective control measures and, thus did not understand how the domestic *aegypti*-control should be done. **Alleged Myth 12: "Using insecticides or the flyswatter, I am already contributing to control the *aegypti*-mosquito"**
X	✓	1.1 % (1 ind.)	Residents did not recognize water-containers removal neither other false measures (such as insecticide indoor application and flyswatter use) as "effective to control mosquitoes". These residents did not know how to control mosquitoes.	Residents not recognized effective control measures and, thus did not understand how domestic *aegypti*-control should be done.
X	X	1.1 (1 ind.)	Residents recognized water-containers removal and also other false measures (such as insecticide indoor application and flyswatter use) as "effective to control mosquitoes"	Residents seemed to not be focused on effective control measures and thus did not understand how the domestic aegypti-control should be done. Alleged Myth 13: "By using protective measures (such as insecticides or the flyswatter), I am already contributing to control the *aegypti*-mosquito"

II.2 IN-DEPTH PERCEPTION ASSESSMENT AND CONFIRMATORY MYTH IDENTIFICATION

(STUDY 3)

BACKGROUND

Results from sub- chapter II.1 suggested that even after experiencing a dengue outbreak, community believed in several myths regarding domestic dengue prevention. Myths (*i.e.* erroneous perceptions) are mentioned as such since they oppose and contradict the procedure which, to date, is considered to be the most effective in *aegypti*-control. However, it is important to notice that these results were provided by quantitative analysis, which can be limited for exploring perceptions, feelings, and beliefs. Qualitative research, which has greater focus on individuals, is thus much able to examine how people integrate their experiences and their deep beliefs [174]. These approaches are in fact opposite in their epistemological basis. Quantitative research conclusions rely on objectivity, validity and reproducibility, while within the qualitative approach, knowledge is gained by inter-subjectivity among researchers and the object of the research [79]. This polarity had divided researchers. By one hand the deductive feature of the quantitative analysis can be criticized by close the research to unexpected results and not fully detect them. By other hand, the inductive feature of the qualitative can be censured as positivist and experimental. The combination of both can take advantage of the potentialities of each approach. This is the basis of the mixed methods data analysis whereby quantitative and qualitative data analysis strategies are combined, connected or integrated to provide conclusions regarding the same research question or aim [174].

Given the direct applicability of current research scope into policy and practice of dengue prevention campaigns, the validity of the perception assessed has particular relevance. In effect, the myths identified by quantitative analysis could have been derived from answers given by chance, (and not by the assumed erroneous perception). In this case, myth identification results would not be not valid in practice. Moreover, questions could be raised regarding the possibility of other (erroneous) perceptions or beliefs which were not detected by the quantitative analysis exist in the community.

Focus group is a technique of collection of qualitative data based on discussion sessions within small groups of individuals [85]. This technique can be used in combination with other methodologies within the same study either in the beginning as a preliminary / exploratory phase or in the end in order to confirm or complement a particular aspect of the study.
In this sense, this study aimed to perform a qualitative assessment of community perception using focus group in order to confirm and complement previous assessment of perception regarding dengue-preventive domestic source reduction.

METHODS

Qualitative perception assessment was performed through focus group sessions (FGS) which were analysed by both deductive and inductive thematic analysis as described below.

PARTICIPANTS SELECTION

Participants of this study comprise an intentional sample which combined three different groups: (i) respondents of the POST-outbreak survey; (ii) parents of students from a primary school; and (iii) workers from the Madeira's citizens Bureau. The first were invited just after completing the questionnaire (all the respondents were invited), the second were invited by the school of their sons/daughters (parents of students from all one-to-three-grades' classes were invited), and finally the third were invited by their work institution (all workers of every hierarchy were invited). In topics where hierarchy seem to not affect, this heterogeneity is argued to be advantageous because it maximises the range of different perspectives within a group setting [89]. From all individuals who accepted to participate, only the ones who lived in Funchal were integrated in the study.
In order to fulfil the objectives of this study (perform a minimum of six focus group sessions until a maximum of one month after the terminus of the POST-outbreak survey) a draw lots of incentives were announced to the participants.

The choice of the institutions involved (primary school and Madeira's citizen Bureau), relied on their geographical location in the Extended-AEGYPTI area. This condition and the type of institution selected ensured that participants had regular routines in the most *aegypti*-infested area, and thus a daily exposure to *A. aegypti*. A sample size of 42 subjects was required to perform a minimal of six group sessions with the seven participants each, as recommended [91,92]. Invitations were made accounting for an acceptance rate ranging from 10-20%.

FOCUS GROUP SESSIONS (FGS)

Groups were made according to participants' availability for the FGS scheduling, gathering a maximum of 14 participants per group. The sessions followed a semi-structured FGSs guide, which allows the moderator to adjusting it to the each session group. The guide consisted of questions regarding dengue and dengue prevention, covering the ten essential concepts from the EP-analysis and the alleged myths identified to be present in the community (sub-chapters II.1 and III.1) in the previous chapters. Focus group sessions were conducted in convenient central places, such as the Madeira's citizens Bureau and Natural History Museum of Funchal (next door to the selected primary school).

A trained moderator guided the discussion. Data was collected by audio recording and notes registration. Sessions were performed during working days at 10am, 12h45pm, 14pm, 16pm or 18h30pm. Each session lasted 45minutes of focus group discussion and afterwards 15 minutes were available for moderator clarify dengue prevention questions from participants. Prior to the starting of the session, participants gave their written informed consent for participation and for the session recording and fulfilled a socio-demographic form. The study was approved by *Instituto de Higiene e Medicina Tropical Ethics Committee*, Instituto de Higiene e Medicina Tropical, Universidade Nova de Lisboa, Lisbon (reference: 09-2013-TD).

PERCEPTION ASSESSMENT

Thematic analysis of data was dynamic and continuous. Since the moderator of FGSs was also the researcher who analysed the data, analysis started through data collection and transcription periods. Recorded information and written notes were transcribed and imported into the qualitative data analysis software package NVivo 10 (QSR International Pty Ldt, Doncaster, Victoria, Australia) for coding and categorising. Passages were coded to as many relevant categories as possible to reduce the likelihood of missing key points in the data. Next to familiarisation with the data and coding, categories were organized into sub-themes, and these in themes (clusters around similar and interrelated ideas or concepts), proving a tree diagram structure [95,179]. Their interplay was analysed using an interpretive descriptive method which goes beyond a mere description and rather aims to provide an in-depth conceptual understanding of a phenomenon [176]. Since the source of participant selection was not relevant for the analysis, data from the three source group were merged and analysed as an entire group. Coding was performed by a single coder and the consistency of coding was ensured by intra-rater agreement of 90th percentile range, calculated as the number of agreements divided by the total number of agreements and disagreements.

The analysis was both deductive, with previously defined categories and inductive, with categories emerging purely from the data. In the former categories corresponded to prior assessed myths and allowed a confirmatory analysis, answering to the question: **'***Are the previously alleged myths actually present in community? If yes, which ones?'.* Inductive analysis allowed an in-depth perception assessment, answering to questions*: 'What are the community's deep perceptions and beliefs?; Do they explain the persistence of the previously alleged myths?; Do they indicate the existence of other myths not previously detected?'.*

DEDUCTIVE-INDUCTIVE DATA INTEGRATION

The integration of data from both qualitative analysis (deductive and inductive thematic analysis) was performed (Table III.2.1 and Table III.2.3). Out of all the assessed/confirmed perceptions in both analysis (Figure III.2.4/Table III.2.1) the ones which were considered to hamper community compliance to the aimed domestic source reduction were gathered in Table III.2.3. These perceptions were classified in 'erroneous' or 'impairing' perceptions. The first are the ones which are known be wrong according to what to date is considered the domestic source reduction procedure (myths). The second are the perceptions which veracity is not confirmed but, whether true or false, weaken community compliance.

Data derived from deductive thematic analysis (Table III.2.1) allowed a posterior integration of both quantitative-qualitative data through triangulation design. In these Mixed-method typology findings from one method (FGS-deductive thematic analysis) are used to corroborate findings generated through other method (quantitative EP-analysis). Data derived from inductive thematic analysis (Figure III.2.4) allowed a posterior quantitative-qualitative integration data through a complementary design. In these mixed-method typology findings from one method (quantitative EP-analysis) are enhanced and elaborated through findings from another method (FGS-deductive thematic analysis). Qualitative-Quantitative results combination is performed in the following Chapter IV.

RESULTS

A total of 58 participants integrated eight FGSs conducted between 7th and 16th of May, 2013. Each session gathered seven participants on average (min.3, max.13)

The mean age of the sample was 44.6 years old (SD=11 years, min=20 and max=69). Regarding the level of education 1.9% of the participants did not study at all, 3.7% had only completed the fourth grade, 9.3% studied until the ninth grade, 57.4% finished high school or similar and 27.8% graduated or had a master or postgraduate degree. The FGS comprised

housewives, students, unemployed and employed persons of various occupational categories in managerial, professional and technical unskilled workers. Among the participants, one subject reported to symptomatic dengue episode. Results are presented separately for both deductive and inductive analysis.

PERCEPTION ASSESSMENT

Deductive analysis

As described in Table III.2.1, deductive thematic analysis showed evidence of several previously alleged myths to be present within the community after the outbreak. Out of the 12 myths alleged after the outbreak, 9 myths were detected as being actually believed by the community (myths 2, 4, 5, 7, 8, 9, 10/11, 12 (Table III.2.1).

TABLE III.2.1: RESULTS FROM DEDUCTIVE THEMATIC ANALYSIS

The list of myths corresponds to the one resulted in POST-outbreak myth identification (sub-chapter III.1, Table III.1.3). Out of those listed, the ones which were assessed during FGS are signed with a *V* and respective citations are given.

Themes	*	Examples
MYTH 1- 'Mosquitoes do not transmit diseases'	-	
MYTH 2 - 'Mosquitoes only cause mild clinical consequences such as allergies, fever, etc.'	*V*	*« The cure in my case, in the case of my son, is very hard, is a very large allergy»;* *«from person to person creates different reactions, and are very serious, my son (...) was so strong so strong (...) People have no notion of danger»*
MYTH 3 - 'Dengue will not occur again in Madeira, it is very not likely'	-	
MYTH 4 - Since I do not feel the byte, I am not at risk of being bitten/infected'	*V*	*«... the concern that fortunately is not mine, I don't think I got bitten (my blood might not be very good)»;* *«Usually when bit bruise»* *«I know that there are some that are more bitten than others, guess the probability of being bitten should also increase, if they are more bitten the probability is greater on them»*

MYTH 5 - Mosquitoes are allocated in a specific area and are not able to spread through the island'	V	*"I think this is a problem more of Santa Luzia»;* *«Now not all Madeira, for example Santa Cruz does not have, all cases that I heard were just in Funchal»*
MYTH 6 - 'Dengue/*A. aegypti* was, finally, eradicated'	-	
MYTH 7 - 'Local health authorities are the key intervenient in the (domestic) control of mosquitoes'	V	*«What I see in tropical countries is pumping these insecticides, and the most critical areas they spend a lot of time with .... pumping all that stuff ...And we do nothing about it »;* *«but there's a lot that can be minimally observed* [by the authorities]*»*
MYTH 8 - 'Insecticides or other protective measures can control mosquitoes'	V	*«Windows nets, the repellent»* *«walk with your arms and legs covered»* *«starting with us, protect us»;* *«you might want to put the net in bed»*
MYTH 9 - 'I am (Community is) not an intervenient in the *aegypt*i-control'	V	*«even if you have a vase with water, a large mosquito reproduction would never happen, is more in the tanks»* *«We know that climate change, caused the install of the bug in the region, we're not going to blame anyone or anything»*
MYTH 10/11 - 'Clean houses or houses without animals do not have mosquitoes / Clean people have nothing to do concerning the control of mosquitoes'	V	*«One of the reasons are the waters, wipes, all this things accumulate, waste, all that»* *«people don't think on the day of tomorrow, there's a lot of dirt»* *«so if you don't have the necessary hygiene, if we offer the conditions to the mosquito it develops»*
MYTH 12 - By the usage of insecticides and/or flyswatter, I am already contributing to the *aegypti*-control	V	*«then something I did, that gives a result, is using the biokill ....»* *«I think that it has to become a habit, blow insecticides everywhere, ... that is effective»*

* Presence in FGS

Inductive analysis

Regarding the inductive approach, three main themes appeared which correspond to three relevant perceptions assessed: (i) confusion in risk perception, (ii) disbelief in domestic source reduction, and (iii) mistrust in governmental entities. These themes comprise several sub-themes and categories as described in Table III.2.2.

Each main theme is subsequently explored, with examples given for each category, and represented in a conceptual map (Figures III.2.1, III.2.2 and

III.2.3). Analysis of these three themes suggested the existence of 23 erroneous (myths) or impairing perceptions.

TABLE III.2.2: RESULTS FROM INDUCTIVE APPROACH ANALYSIS

The main categories identified are presented along with respective sub-themes and themes in which they are clustered. Suggested related myths/impairing perceptions derived from each category is described by its numbering/lettering (perceptions are presented at length in Table III.2.3)

Themes	Sub-themes	Categories	Myths / impairing perceptions
(i) Confusion in risk perception	(Adequate risk perception)	Risk of DF/DHF	-
	Over-estimated risk perception	Allergic reactions	A
		Health consequences	J
	Under-estimated risk perception	Intrinsic protection to MQ* bite/DF	D, F
		Gained protection to mosquito bite	E
		Disconsider DHF	B
		Gained protection to DF/DHF	I
		DF severity in Madeira	C
		DF Severity & personality, psychological stability	H
		DF severity & health status	G
(ii) Disbelief in domestic source reduction	Disbelief in the relation between water and bs**	Water is not related to MQ	P
		Weather	N
		Trees	P
	Non-recognition of *A. aegypti*'s domestic /urban attribute	Natural & public environments (large water collections)	L, M
		Semi-natural & agricultural env.*** (large/dirty water collections)	O
		Small-cattle production	
		Absence of hygiene in public areas	M
	Demotivation with domestic source reduction	Domestic-source-reduction inefficacy	Q
		Domestic-source-reduction hard procedure	R
		Domestic-source-reduction vain efforts	S
(iii) Mistrust in governmental entities	Expectations on turnkey or vertical interventions	Misinformation about measures limitations and availability	K
	Governmental negligence	Lack of awareness regarding governmental initiatives/outcomes	U
	Short dengue risk divulgation		V
		Belief in home-made solutions	T

***** Mosquito; ****** breeding sites**; ***** environment

(i) Confusion in risk perception

Participants diverged in their dengue risk perception, mainly according to their experience, but also to their level of knowledge. The observed risk perception is represented in Figure III.2.1.

Several dengue-related risks were mentioned based on personal experiences or of their relatives, friends and acquaintances. The main shared experienced episodes were: mosquito bite, allergic reactions, dengue fever, health consequences and dengue haemorrhagic fever. Participants revealed an experience-derived risk-perception, which varied from over-estimated risk, an adequate risk and an under-estimated risk.

Out of those who over-estimated risk, some participants considered as frequent the eventuality of suffering extreme permanent health consequences, others saw allergic reaction as dangerous condition itself.

Allergic reactions

«It's normal, I'm allergic to the bite of insects, if I take a bee bite, I have to go soon to the urgency, I'm bloated, I have bruises in the head, in the neck (...) that worries me a lot because of my own daughter (...) Although I know she don't have allergies. But the mosquito of dengue is out there, and she can be bitten anytime, and I, as a mother, and I think all of us, have that anxiety»

Health consequences

«the different reactions after the bite concern me»; «... a case of a boy who after having been bitten turned abnormal, with irreversible consequences.»; «The daughter of a friend of mine (...) she got it, never recovered, she have never been the same. She is a young girl with 25 years old, but she is always with problems»; «Liver is where it normally affects more, in the liver affects much more»; «By taking the bite some people have lost vision»;

Finally participants who under-estimated risk did not considered risk of having DF and/or DHF.

For instance, people who did not feel the mosquito bite (*i.e.* those who did not admit mosquito exposure or AME) believed to not being bitten by mosquitoes, due to some personal characteristics that had "protected" them. People who AME, but who did not have personal experience of dengue fever, also believed to have been favoured by some factor as eventual limited mosquito distribution in the city, a particular type of blood, eating, or something unspecific.

> ***Intrinsic protection to mosquito bite/DF***
>
> *«.... Since I was a child I never had problems. Once we had the mill, piles of dirt… »; «I have a sister there. Is there for so many years and never caught it and there are other people who haven't picked it up [*dengue*], it doesn't mean that I will catch »; «I am very bitten (...) but I never got it»; «I don't catch flus, for example»; «some component in his own blood that makes it closer to some people than to others»; «is the lack of vitamins»; «perhaps the blood type »; «It is the immunity system »; «If it is lower or if it's high, if you're strengthened, if it has vitamins, if you're strong, diseases are not transmitted so easily than when we have the immune system ...»*

A "protection" factor was also perceived by those who AME and who also have experienced a decrease in mosquitoes-derived allergic reactions throughout the years of contact with the mosquito.

> ***Gained protection to mosquito bite***
>
> *«The mosquito (...) bit (...) made a bubble that became red around. No, but this was four years ago. Now (...) I have never been bitten »; «But from year to year, I noticed that the body is reacting differently »; «Although now the reactions from year to year are different (...) now just itches. But at the beginning it was terrible»*

Based on different reasons, several participants disconsider the eventuality of DHF. Some participants who shared dengue experiences disregarded it since they revealed to have realized the disease is curable. Some of these participants revealed to be more worried about other known illnesses transmitted by mosquitoes.

Disconsider DHF

«As long as it is treated timely and properly it is cured»; «people who had dengue are healed»; «Because in Brazil and Venezuela, their daily routine is dengue and however there are no deaths, there are no very severe cases ....» ; «But even more worried about other diseases which may arise through the mosquito. »; «Other things, malaria.»

Some participants admitted that locals can gain immunity to this severe form over time.

Gained protection to DHF

«I know that comes to a point that immunity is acquired by own population, as happens in other latitudes and in Venezuela. »; «There are other countries who are living with this problem, but is also true that they also already have immunity, which we don't have»;

Other participants have disregarded DHF in the Island. Based on the non-occurrence of the severe dengue forms in Madeira, some participants believed that dengue in Madeira was generally less aggressive comparatively with other dengue endemic countries (DEC). DHF was poorly understood by most participants even by those who recognised the existence of severe and lethal forms of dengue. Conditions such as, immunity, health status, personality or temperamental mood were perceived as determinant variables in the disease evolution.

DF severity in Madeira

«In Madeira there is not the true dengue fever, the mosquito mated. If existing the true dengue fever there would be already a lot of hemorrhagic fever»; «And I remember to hear about dengue in Brazil (...) I was horrified when I saw that hemorrhagic dengue kills (...) now, after seeing what I've seen, that nothing happened like this»

DF severity & personality, psychological stability

«Not all people who have hemorrhagic dengue die. Only those who are weakest»; «If I were bitten I may would have react differently »; «I have a friend, she is extremely thin, she was going through a difficult time, the divorce, she was just down and she caught dengue fever. She said it got her diarrhea, vomiting, she had no forces and could hardly contain herself up. Someone else had dengue, another friend of mine, said it was like a small flu, he is an older gentleman who is a more positive person with good alimentation, unlike my friend who was very weak because of the situation, he says that he had a small fever as if the flu didn't give him anything in particular and the doctor diagnosed him dengue»; «A person is depressed, it can influence the state»;

DF severity & health status

«If the person is really sick and is bitten by the mosquito can became very bad»; «Diabetic people can become bad, and never heal»; I am concerned with the age that I have and with the problems that I have of asthma (...) if I catch dengue what might happen to me »; «I think there are certain diseases that already weakened a person, and maybe that's the point more important. »; «That varies with the, there comes a time when we're best and a time when we're worse»; «certain people are most vulnerable, people who were down, they become miserable with pain. And powerless without energy»; «I think people have to take care of themselves, take vitamins»; «it depends on the immune system, that I think is very important»

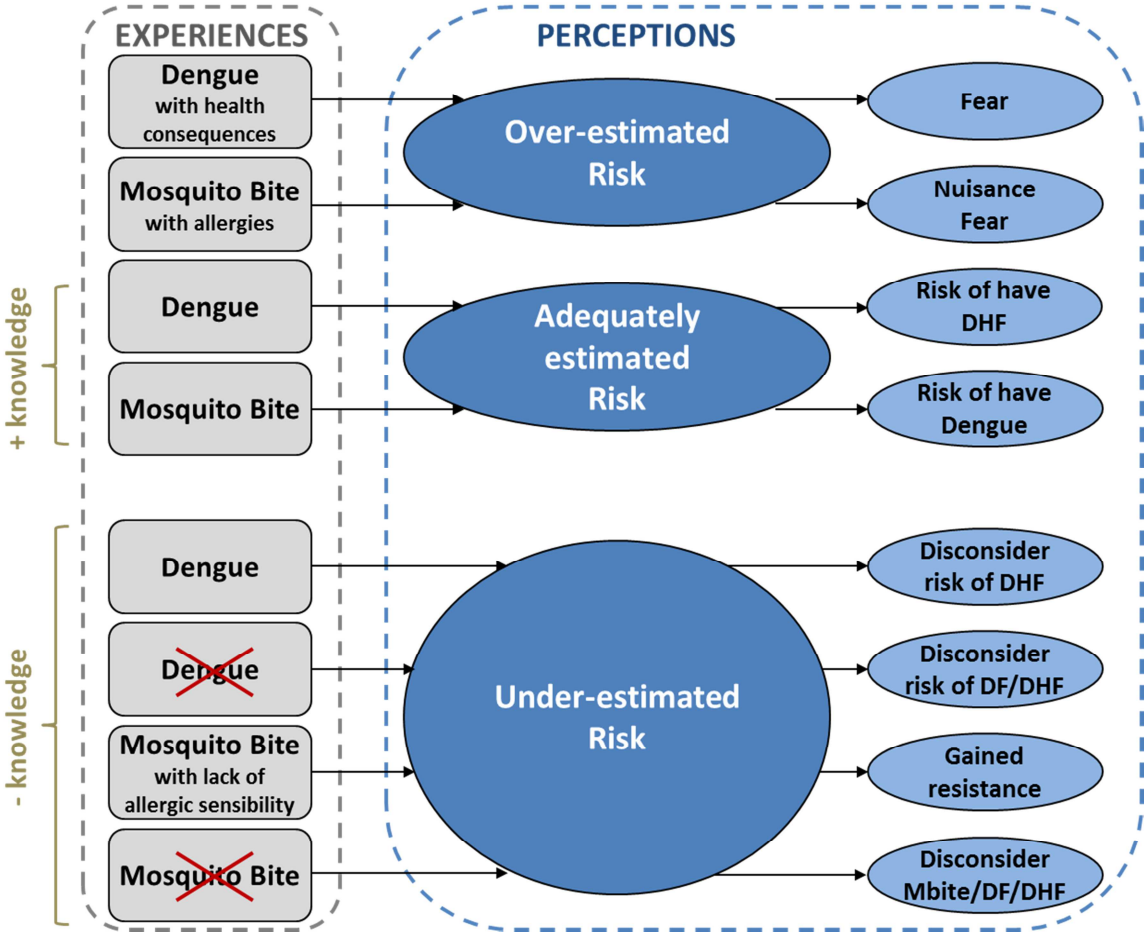
Those who adequately perceived risk considered eventuality of having DF and/or DHF. This perception was accompanied by a high level of acknowledgment regarding dengue medical importance.

Risk of DF and/or DHF

«My worry that...the second time, if again bitten, is much more serious.. derives to the hemorrhagic. Because it has several strands, it seems. This dengue fever, last year, was one but this year may be different. ... It's still a bit unknown»; «Because it is also said that dengue may have passed by them and have not reacted, and it doesn't mean that in the next strain they won't react much worse. That worries me a lot»; «Because people do not have much information, the first reaction is to think "it is a flu"; «Maybe some people are less prone to be bitten, but all those bitten have the risk of having dengue..»

FIGURE III.2.1 – CONCEPTUAL MAP REPRESENTING 'CONFUSION IN RISK PERCEPTION'

Diagram shows: (i) experiences, in grey (ii) risk perception, in blue (adequate, over-estimated and under-estimated), and (iii) associated level of knowledge, in brown. The red-cross above an experience means its non-occurrence.



(ii) Disbelief in the domestic source reduction

Most of participants revealed a disbelief in the aimed domestic-*aegypti* control, regardless of their level of knowledge concerning breeding sites and control measures. As represented in Figure III.2.2, there were found three different perceptions (sub-themes) which led to this disbelief, namely: (i) disbelief in water-related breeding sites, (ii) non-recognition of *A. aegypti*'s domestic and urban attributes, and (iii) demotivation with domestic source reduction.

The first is caused by confusion between mosquito proliferation factors and causes to mosquito invasion and also a lack of prior experience of water as being an inducer of mosquito proliferation. Consequently, other factors such as, weather and trees, mainly some specific palm-trees, were seen as the causes for *A. aegypti'*s appearance in Madeira, and also believed to be the main factor of its current proliferation. Plants, trees and particular gardens are seen as the places were mosquito breeds. Most participants did not know the term breeding-site.

Water is not related with mosquitoes

«There have always been stagnant waters ... I don't know ... and many wells, and there's never been this mosquito»; «they took it, in this moment the lagoon is empty, is not only because of the still waters»; «now this which is inside him or taken from outside, is this part that I also don't have much .... If it take it from waters or if it is the mosquito itself that already have it, I don't know»

Weather

«our climate is propitious»; «The humidity. Our climate is favorable to it »; «We know that climate change made that the bug had installed here in the region, we're not going to blame anyone or anything»

Trees

«The trees, maybe the trees »; «But those palm trees, those palm trees which existed around, they attracted many mosquitoes back there»; «... such trees... »; «the plants »; «also these corners are situations where immense grass grows »

Some more informed participants identified water to be related with mosquito proliferation (*i.e.* to be the mosquito breeding site), but did not recognize *A. aegypti's* domestic and urban attributes. In fact, they believed that large water collections, such as city streams, irrigation streams and falls, lakes, and irrigation tanks, to be the actual breeding sites. Therefore,

natural or semi-natural areas (*e.g.* public gardens and parks) and rural and agricultural environments (*e.g.* private cultivated lands) were seen as the main areas where *aegypti*-control should be done. Frequently, the role of these places as mosquito breeding inducers was perceived to be associated with their eventual lack of hygiene.

Natural and public environments (large water collections)

«There is also "n" natural situations that it is almost impossible to avoid »; «The stagnant waters »; «streams»; «it is enough just leave the house, passes along the stream, to be bitten»; «The streams have more propensity»; «In summer they come most of the streams»; «the streams are also still in summer»;

Semi-natural and agricultural environments (large water collections)

«so we all have irrigation water, the called irrigation water, which comes from the water fall, sometimes it obstructs, irrigation water sometimes congests with banana leaves »; «it should exist there wells, or whatever, or some water fall»; «even if you have a pot with water, it would never happen a large mosquito reproduction in it, it occurs more in tanks»; «The wells uncovered»; «The irrigation channels are all destroyed, that is chaotic»

Small-cattle production environments

«The big problem are domestic animals, that little piggy, the bunny, (...) is part of a culture (...) nowadays with the crisis more people go to agriculture, more small-cattle will be owned. The bunny, the pig, it creates a humidity that is a great thing for mosquitoes development»

Absence of hygiene in public areas

«There are still dumping of rubble in the streams, there is still much that trend»; «the sewers are uncovered»; «There are streets that have

many sewer, smell really bad, and have a lot of mosquitoes»; «worried about the lack of hygiene, waste bins»

Finally, participants who recognized breeding-sites to occur inside and around domestic areas, have also shown a disbelief in domestic source reduction, mainly caused by their demotivation regarding domestic source reduction procedure, outcomes or its lack of supervision. These individuals felt this control activity to be inefficient and/or vain due to (i) the role as source of breeding sites of the empty houses and common lands (very frequent in the city), (ii) uncertainty about whether or not their neighbours also perform source reduction in their domestic areas, and (iii) the perceived continuous presence of mosquito even after domestic source reduction have been performed. Participants who told to practice domestic source reduction were disappointed and felt impotent in preventive collaboration. Other participants mentioned this activity to be difficult to perform, and believed that the aimed domestic source reduction would be hardly achieved.

Domestic-source-reduction inefficacy

«*Do you think it's possible that this happens?* [talking about domestic source reduction]»; *«I did that, everything, took vases, animals (...) I took this from the tires »; «Despite of the measures they are always bitten»;*

Domestic-source-reduction hard procedure

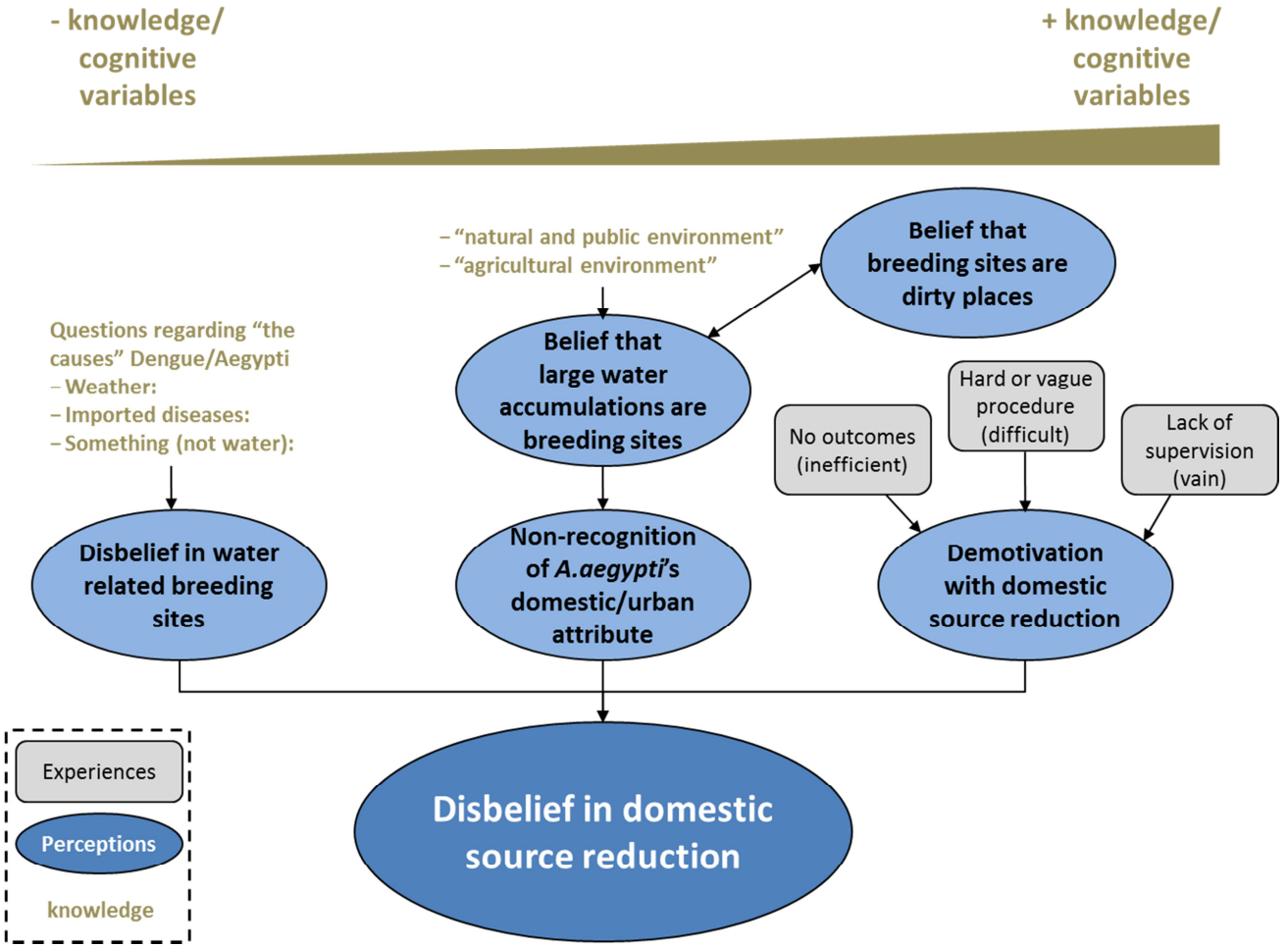
«Difficulty in ending the mosquitoes»; «a global prevention set looks very complicated»; «This of take the water out of the flower plants, this type of flower if it rains a little bit, the people have to be very, very alert, to pump the water »; «shared with us still waters, trying to avoid, but that feeling, that is not always enough »; «If we have jars, how long should we change the water, what is the truth, if we should pour vinegar, if we should not pour vinegar»; «Regarding the plants, it is hard to pump the water»;

Domestic-source-reduction vain efforts

«…abandoned plots, which can accumulate water and therefore serve as breeding grounds for mosquitoes. And there must be an intervention, I don't know how. The empty lots and houses can create mosquitoes and after that you can't control»; «There are abandoned houses that have stagnant waters»; «There should be an Audit Board '; «How to do it in the trash, if a person does not separate the trash takes a brutal fine .... have to do inspection. »; «all things that weren't fulfilled the people caught a fine and paid even strong and ugly»; «There had to be an authority to supervise», «I try to do my part, now I hope also that the part of the Government's is being done»

FIGURE III.2.2- CONCEPTUAL MAP OF THE PERCEPTION 'DISBELIEF IN DOMESTIC SOURCE REDUCTION'

Diagram shows: (i) experiences, in grey (ii) derived perceptions, in blue; (iii) alleged resultant attitudes and behaviours, and (iv) associated (level of) knowledge, in brown.



(iii) Mistrust governmental entities

Several participants revealed a mistrust regarding governmental attitude, messages and interventions, as described in Figure III.2.3. These individuals shared an expectation of a higher governmental intervention and support. Some of those expect authorities to implement solutions such as vaccines, powerful insecticides or pills, rather than source reduction strategies. Misinformation about these interventions availability and their limitations make community to believe in them as existing turnkey solutions. Participants also revealed to expect the government to intervene in different ways, in the control and prevention. They also showed to be disappointed with the vertical solutions performed.

> ***Expectations on turnkey solutions and/or vertical solutions (Misinformation about measures limitations and availability)***
> *«In Brazil and Venezuela, who live with that every day, they must have something to protect them, not this thing»; «... medicine you can import ... »; «I think that it should be already exist a vaccine»; «What I see in tropical countries is spraying these insecticides, and the most critical areas they spend a lot of time spraying all that stuff...And we do nothing like that» ; «...The disinfection»; «..but there's a lot that can be minimally surveyed » «spraying the walls with those insecticides as they do in Brazil and Mozambique also...»*
> *«…there should be support from authorities, as they did with the fruit fly»;*

Even within those who have identified one or more government-implemented preventive initiatives, several complained about the delay of their application, executed only after dengue emergence.
Moreover, several participants believed that the government was the responsible for *A. aegypti* invasion and infestation into Madeira Island. According to them, the first eggs or adult mosquitoes were brought in some palm trees, assumed to have been imported by the government.

Therefore, the emergence and the persistence of the *A. aegypti* in the island were hence seen as governmental negligence. Furthermore, it created a feeling of impotence and injustice which consequently made them impute to the authorities the responsibility for the problem solution. This perception led community to mistrust in governmental actions and messages becoming more prone to search for and adherer to home-made unreliable solutions.

> ***Governmental negligence***
> (***Lack of awareness regarding governmental initiatives/outcomes)***
> *«Unfortunately they came from palm trees»; «When it started appearing the large ones, they said they came from these palm trees» «If until today entities responsible for this have not taken a position to face this, this is very hard to start for us. I know that we are here willingly and we want this to go forward, but if people who are ahead of all of this does not go forward this don't work»; «When the mosquito of Santa Luzia started, there was so much so much that was made. What? Nothing!» ; «I don't know if whether by administrative or by politics, but the threat was not taken very seriously»; «It begins with those who have responsibility» ; «[authorities made some initiatives].. but only after the entrance of the mosquito» ; «I can give an example, I have two tanks near my house, wells, and I made four participations to the Municipality and nobody does anything, and there the waters are still» ; «If they have bothered in repairing irrigation-water pipelines and give a hand to the people, to those that really had no possibilities (...) for example safeguard their wells and cover them, for our beautiful land, nobody had that caution, no one!»*

Some participants also claimed for a short dengue risk disclosure by government. Based on the preservation of the local tourism economy and on the avoidance of generalised alarmist reactions, some participants were comprehensive of such governmental performance. Even though, most of them believed these reasons to be unworthy.

Short dengue risk divulgation

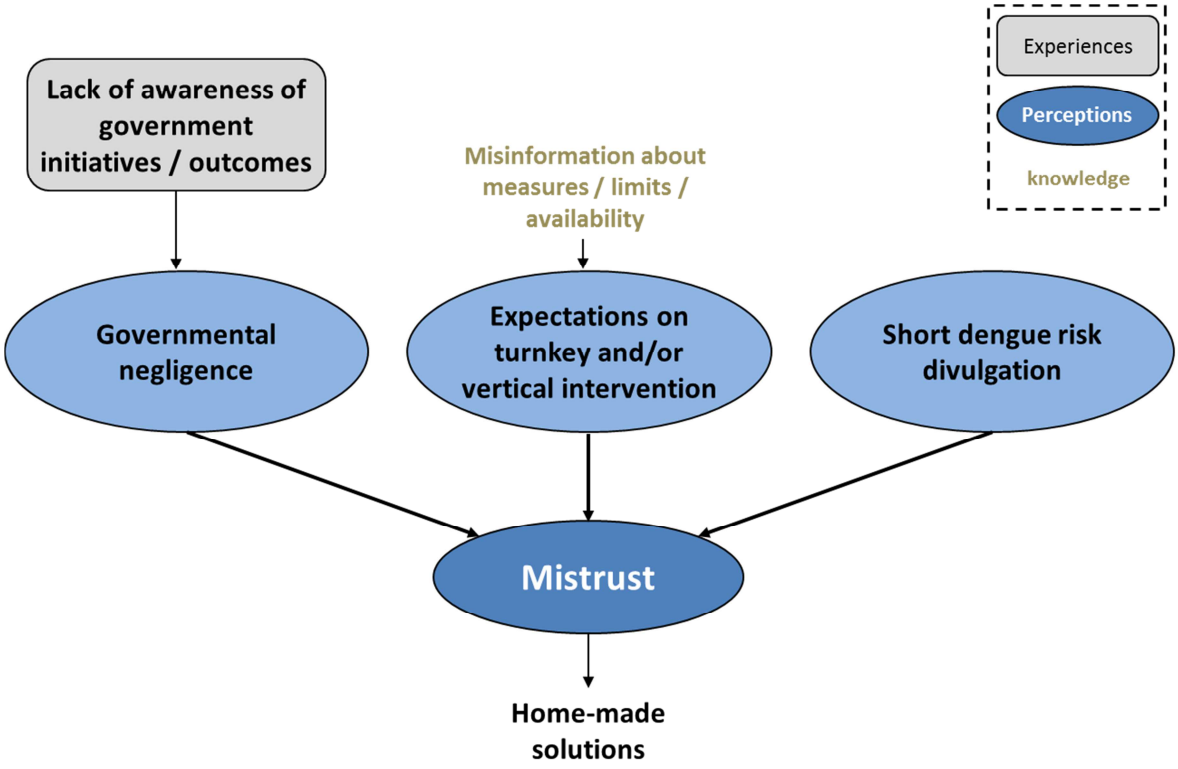
«I find it very important that health authorities have ... a very strong role (...) who's inside, who knows, who knows the truth, what and who knows what is being said, we need to tell people to do this or that»; «All people should be informed in order to prevent their selves, and if people are informed they will prevent their home and the rest of the street»; «it should be more publicized within the population.»; «I think that little information was given in relation to dengue»; «the population has to be properly clarified»; «It could have being done more awareness-raising actions with the people, in general, to inform»

Belief in home-made solutions

«Some day I red, but i am not sure whether that was true»; «Jellies prescribed by pharmascists» ; «Nettle infusion» ; « to take brewer yeast is also good to prevent mosquito bite» ; «If we made nettle infusion and then water the plants with the infusion, since they don't like nettles it avoids mosquito oviposition in these plants» ; «the same happens with coffe grounds»; «also in the pot, they say, the coffe grounds» ; « Citrnella, honey and bleach» ; «I took vitamin B for six months and that helped me to avoid mosquito bites. I felt that allergic reaciton it was not the same»

FIGURE III.2.3- CONCEPTUAL MAP OF THE PERCEPTION 'MISTRUST IN GOVERNMENTAL ENTITIES'

Diagram shows: (i) experiences, in grey (ii) derived perceptions, in blue; (iii) alleged resultant attitudes and behaviours, and (iv) associated (level of) knowledge, in brown.



**

Some participants revealed apart from these three main perceptions above described, as being aware of the community's responsibility in controlling mosquitoes. They also shown to be able to distinguish preventive behaviours from protective ones, revelling to recognize priority in the first ones. These individuals, differently from the remaining, were not only the most informed ones regarding both dengue risks and *A. aegypti*'s breeding sites, but also were aware of government preventive initiatives. These individuals claimed the lack of awareness and of preventive actions within some groups in the community. Most of them also suggested supervision policies as a strategy for attaining more effective outcomes in domestic source reduction.

Community role perception

«We cannot expect that they [the government] *solve the problem, it has to be all of us»; «they have been doing an incredible work, door-to-door..» ; «I think that nobody is free of that happens. If a second infection can be more severe, as have been spoken, the truth is that no one is free »; «…regarding the appearance of a new serotype, and that makes it even worse. That derive to hemorrhagic dengue, the risk in the last line is dying ... is serious»; «I'm not saying that we don't have to protect us, that's not what I meant. I think the most important thing is start from the other prevention and then….»;*

Results from both deductive and inductive analysis were integrated providing: (i) an overview of community perceptions assessed, presented in Figure III.2.4; and (iii) a whole list of myths and impairing perceptions within the community, described in Table III.2.3.

In Figure III.2.4, perceptions presented previous conceptual maps (Figure III.2.1, Figure III.2.2 and Figure III.2.3) are integrated in a complex interplay between them. This suggests pathways from perceptions/beliefs/feelings to resultant attitudes/behaviours.

In Table III.2.3 myths and impairing perceptions assessed in both approaches (inductive and deductive) are gathered in a unique list which also describes causal and consequential perceptions.

These results provide an in-depth understanding of the community perception, reveal what is impeding domestic source reduction compliance and explores what is in the basis of those cognitive/emotional obstacles.

FIGURE III.2.4 – OVERALL PERCEPTION MODEL – integration of Figure III.2.1, Figure III.2.2 and Figure III.2.3

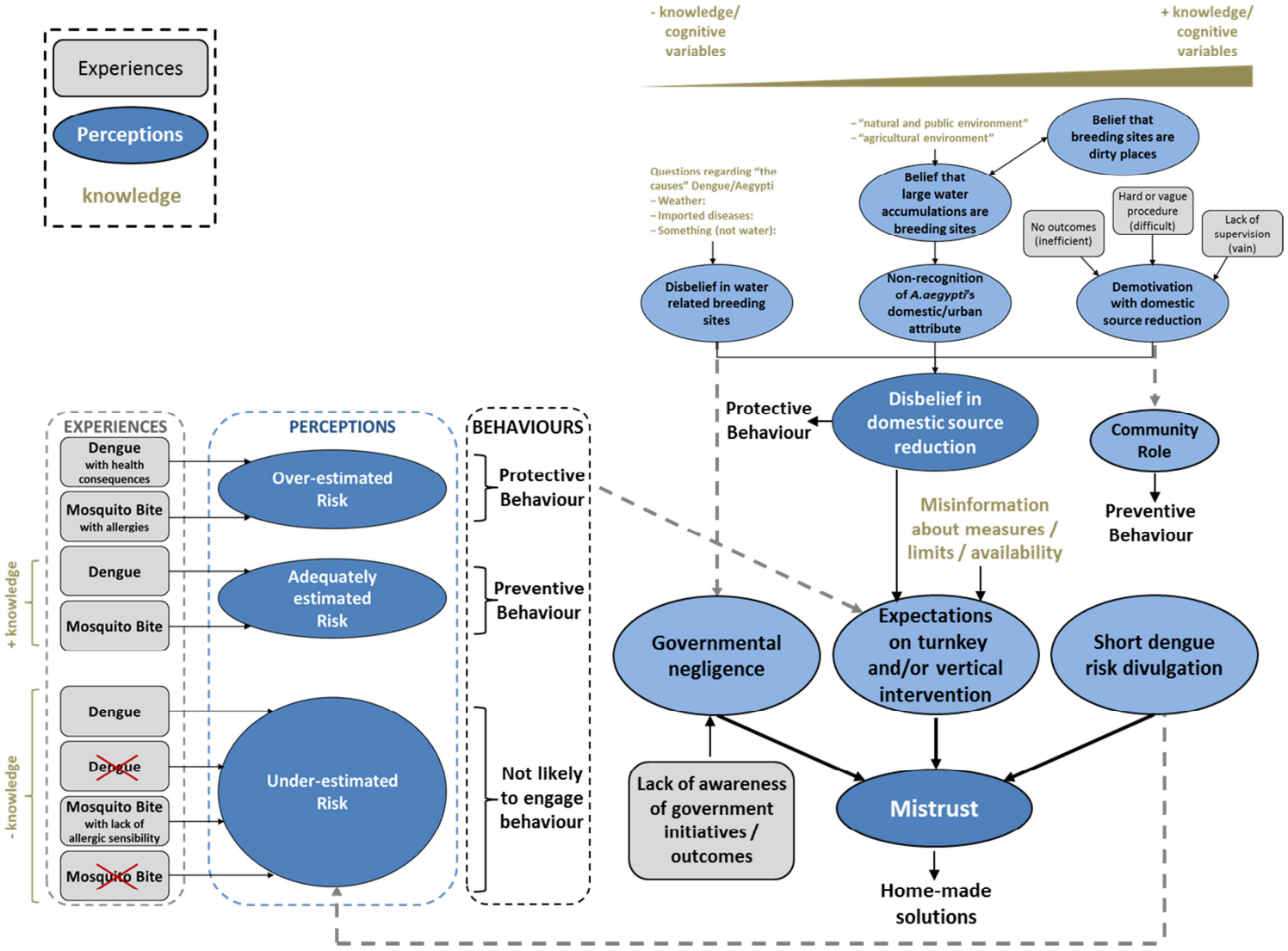


TABLE III.2.3: OVERALL LIST OF THE ERRONEOUS AND IMPAIRING PERCEPTIONS

Results both from deductive and inductive analysis. Inner positioned perceptions are inter-dependent or resultant from perceptions presented in outer positions. Deductive-derived perceptions are lettering signed and inductive-derived perceptions are numbering signed.

ESSENTIAL TOPICS	OBSTACLES TO DOMESTIC SOURCE REDUCTION COMPLIANCE ERRONEOUS PERCEPTIONS (MYTHS) / IMPAIRING PERCEPTIONS		
MEDICAL IMPORTANCE	1	'Mosquitoes do not transmit diseases'	MYTH
	2	'Mosquitoes only cause mild clinical consequences such as allergies, fever.'	MYTH
		A – ' The nuisance resulted from a mosquito bite is a much dangerous than DF or the sole dangerous condition'	MYTH
		B - 'Dengue is only a treatable flu'	MYTH
		C - 'Dengue in Madeira won't have the same clinical consequences present in other countries '	IMPAIRING PERCEPTION
		D - 'The type of blood or of diet can protect from mosquito bite'	MYTH
		E - 'Lack of sensitivity to allergic reactions reveal an gained resistance to mosquito-borne diseases'	MYTH
		F - 'The type of diet determine whether dengue is or not transmitted during a mosquito bite'	MYTH
		G - 'Dengue severity is related to health status (*e.g*. diabetes or asthma)'	IMPAIRING PERCEPTION
		H - 'Dengue severity is related to personality and psychological stability'	IMPAIRING PERCEPTION
		I – DF/DHF resistance can be gained over time	MYTH
		J - 'Dengue commonly provokes permanent severe health consequences (*e.g.* lack of vision)'	MYTH
LOCAL RISK	3	'Dengue will not occur again in Madeira, it is very not likely'	MYTH
	4	'Since I do not feel the byte, I am not at risk of being bitten/infected'	MYTH
		D - 'The type of blood or of diet can protect from mosquito bite' *	MYTH
		E - 'Lack of sensitivity to allergic reactions reveal an gained resistance to mosquito-borne diseases' *	MYTH
	5	'Mosquitoes are allocated in a specific area and are not able to spread through the island'	MYTH
	6	'Dengue/*A. aegypti* was, finally, eradicated'	MYTH
DOMESTIC ATTRIBUTE	7	'Local health authorities are the key intervenient in the (domestic) control of mosquitoes'	IMPAIRING PERCEPTION
		K - 'Turnkey solutions (*e.g.* vaccines) and vertical interventions (*e.g.* governmental-based source reduction) are available and effective'	MYTH
	8	'Insecticides or other protective measures can control mosquitoes (in the domestic area)'	MYTH
		P - 'Mosquitoes don't derive from water'*	MYTH
		T - 'There are home-made solutions that effectively avoid mosquito breeding, biting or transmission'*	
	9	'I am (Community is) not an intervenient in the *aegypti*-control'	MYTH
		L - 'Natural large water collections are *A. aegypti*'s breeding sites (*e.g*. city streams)'	IMPAIRING PERCEPTION
		M - 'Public areas (both clean or dirty) have *A. aegypti*'s breeding sites (*e.g*. lakes in gardens)'	IMPAIRING PERCEPTION
		N – 'Weather is the main determinant of mosquito population growth'	MYTH

Mosquito Breeding	10 and 11	'Clean houses or houses without animals do not have mosquitoes' and/or 'People living in these houses have nothing to do concerning the control of mosquitoes'	Myth
		O - 'Agricultural and small cattle environments induce mosquito breeding'	Impairing perception
	P	'Mosquitoes don't derive from water'	Myth
Control Measures	12	'By the usage of insecticides and/or flyswatter, I am already contributing to the *aegypti*-control'	Myth
		P - 'Mosquitoes don't derive from water'*	Myth
		Q - 'Source reduction activities are ineffective'	Impairing perception
		R – Source reduction activities are hard to perform correctly'	Impairing perception
		S - 'Without policy and supervision in inhabited and non-inhabited areas, domestic *aegypti*-control is vain '	Myth
		T - 'There are home-made solutions that effectively avoid mosquito breeding, biting or transmission'	Myth
(Feelings)	U	'Government was/is negligent regarding dengue prevention'	Impairing perception
	V	'Dengue health risk could have been much divulged'	Impairing perception

* Some perceptions are repeated since they may be related o more than one Essential Topic

DISCUSSION

Discussions and shared experiences derived from FGS have confirmed the existence of most myths previously alleged as being present within the community after the outbreak.

Myths 1, 3, and 6, not detected within this FGS qualitative analysis, may or not be present in the community. In fact, due to the selected intentional sampling, FGS participants may had not included people who believe in those myths. Curiously, if existing in the community, the low risk perception implicit in these myths could had discourage people believing in them to join dengue-related FGS.

Inductive-driven thematic analysis revealed the existence of several new perceptions in the community, which were not detected by EP-analysis. Moreover it deciphered what was on the basis of the assessed community perception, explaining their consequent actions. Misinformation, motivations, experience-based intuitions, beliefs, feelings and judgements were found, as described in following paragraphs and presented in Figure III.2.3.

The experience-based underestimation of risk generated several erroneous perceptions (myths). It is certain that (i) dengue scenario in Madeira, was actually less severe than in countries with multiple dengue virus serotypes, (ii) that some people are really less attractive to mosquitoes than others, (iii) and that dengue syndrome develops heterogeneously in different people, as mentioned by some participants. However, since other factual risk notions were not recognized, risk was probably erroneously perceived. In fact, there are imperceptible and painless mosquito bites, a high frequency of asymptomatic dengue cases, a possibility to other dengue serotypes enter in the Island, and the odds of not have being bitten and not have had dengue just by chance. Misperceiving risk, these individuals were not motivated for taking preventive actions, and may have thought that people should get use to dengue and mosquitoes sooner or later.

In contrast, dengue experiences lived by well-informed individuals resulted in an increase of risk-perception, and thus in an increase of precautionary motivation (motivation for take cautious actions). These individuals are more likely to engage in preventive behaviour and also to be interested in other topics which will help them to be more efficient in that action.

Experiences of extreme allergic reactions or health consequences, also increased risk-perception, due to the fear they had provoked. Even though these individuals had also more precautionary motivation, they are more prone to search protective action rather than preventive ones (myths 8 and 12). This insight is consistent with the Extended Parallel Process Model which states that, when individual ability to control a risk is perceived as being low, even if the severity and susceptibility is perceived as high, individuals are likely to take steps to control their fear instead of acting to control the danger (fear control) [67]. Moreover, there is an opposite tendency for preventive versus protective behaviours which was also described in other perception assessments studies [62][177].

The individuals who disbelieved in domestic source reduction have probably looked at the government as the key intervenient of dengue prevention (myths 7 and 9). The observed misperceiving large water accumulations placed in public environments was also described in other

studies [160,181]. The observed association of mosquitoes with lack of hygiene have emphasized the non-involvement of all who believe to live in clean, urban areas (basis of myth 10 and 11). This association may be explained by community's short contact with mosquitoes and an eventual confusion with flies which can actually be related with food debris, animal's faeces or garbage. This erroneous perception was also observed in other dengue communities [179]

Participants who were demotivated and frustrated with the domestic source reduction, had probably also focused their efforts in protective measures rather than in preventive ones (myths 8 and 12). Moreover, even within those who believed *A. aegypti* to breed in domestic environments some did not excluded that this species can also breed in larger and dirtier water accumulations. Therefore, these participants believed that natural, semi-natural and agricultural environments were sources of mosquito.

Finally, mistrust on governmental decisions is, out of the main three community perceptions observed, the one which most impairs community engagement in domestic source reduction. In fact, this feeling may promote the other two main perceptions, and to be simultaneously promoted by them, creating a self-supplied cycle of myths perpetuation and community non-engagement. Studies about beliefs strength state that they may be originated due to evidence of untrustworthiness of its source, but it quite often is founded rather on the trust in other sources that have vouched for an alternate belief [180]. In the first hypothesis, mistrust in public institutions, lead to community uncertainty on which information believe or what decision to take. This condition will increase the gap between what is said in health-messages and what is believed and actually accomplished by the public. The second hypothesis in the context of this work means that, even those who not judge past and present government decisions may distrust their health-messages or behaviour-proposals regarding domestic source reduction, by simply trusting more in other opposite ideas or solutions, such as the non-realistic turnkey preventive solutions. Thus, based on their perceptions, some individuals were expecting different governmental actions, such as: implement effective

vaccines, import adequate treatments, spray potent insecticides, take attention to the assumed (semi)-natural breeding sites placed in public areas and to improve its hygiene; intervene in empty houses and/or common lands; police the domestic *aegypti*-control by penalizing those who do not perform source reduction activities in their domestic area or guarantee governmental-performed domestic *aegypti*-control. Regardless of their reasonability, when these expectances are disappointed, mistrust on government increased. Similar conclusions were assessed in other dengue-related community perceptions assessments [62].

Some few participants have shown cumulated knowledge regarding dengue risks and *A. aegypti* breeding sites. Those were also aware of the governmental initiatives, and of their limited ability to solve the problem alone. These participants have fully perceived the community role.

The present conclusions are determinant for guiding future campaigns. They allow professionals to distinguish which topics require cognitive clarification (such as risk perception) from others, which being intuitive, require initiatives to actually change community's reality and thus their perception (such as the demotivation with outcomes).

Overall the assessed perceptions were coherent with the Madeira's dengue prevention scenario, explaining the persisting barriers to community engagement despite governmental efforts performed throughout the last years.

CHAPTER IV: FINAL DISCUSSION

GENERAL DISCUSSION

This work is to our knowledge the most comprehensive description on community perceptions regarding dengue prevention in short-term dengue epidemic communities. It provides both quantitative and qualitative assessments of Madeira's community perception regarding vector-control strategies based on source reduction of *Aedes aegypti*'s breeding sites (denoted domestic *aegypti*-control or domestic source reduction), exploring how knowledge and experience have modulated it.

The results obtained have accomplished the objectives defined in this thesis of assess community perceptions in Madeira Island and to explore how it is altered by a dengue outbreak experience.

PERCEPTION ASSESSMENT: QUANTITATIVE AND QUALITATIVE DATA

It is remarkable how the same data set provided different results accordingly to the methodology used for their analysis. By simple descriptive analysis of quantitative data one could say that after the outbreak, 97.7% of the residents of the most infested-areas in Madeira Island perceived that source reduction activities are effective in mosquito control. However, through cumulative quantitative Essential-Perception analysis (EP-analysis) one observes that less than 40% of the same population actually believed in the latter activities, and did not believe in other ineffective, but easier to implement measures, such as insecticide spraying. Moreover, by qualitative thematic analysis one can understand that a disbelief in domestic *aegypti*-control is one of the main perceptions responsible for impairing community compliance with these source reduction activities.

These contrasting, but also complementing, results show that the use of EP-analysis and of (quantitative-qualitative) mixed methods analysis were fundamental in providing an overall accurate and in-depth assessment of perceptions.

In effect, qualitative findings supported the quantitative EP-analysis results in several aspects. Such as previously assumed in the assumptions of the

EP-analysis (Additional File II.1.2), the qualitative-based overall perception model also revealed that a minimal set of particular relevant perceptions are required for community behaviour compliance (Figure III.2.4). As examples, 'risk perception' alone did not ensure a healthier decision-making, and the knowledge regarding domestic *aegypti*-control was also not enough to generate the needed precautionary motivation to adhere to it. Therefore, a cumulative-minimal-perception was consistently confirmed to be essential for behavioural compliance.

Moreover, all topics defined as essential within EP-analysis were also coherently identified in the overall perception model derived from the qualitative analysis. 'Risk perception' theme covers previously analysed 'medical importance' and 'local context' topics and the '(dis)belief in domestic source reduction' covers 'domestic attribute', 'mosquito breeding' and 'control measures' topics. Moreover, 'control measures' is also slightly covered within 'mistrust in governmental entities' theme. Additionally, almost all myths suggested to be believed by the community after the outbreak, were reliably related to the qualitative perception assessment results, as described in Table III.2.3 (previous sub-chapter III.2).

Nevertheless, the decrease in risk perception derived from the outbreak experience and the '(mis)trust in governmental entities' were exclusively assessed in the FGS thematic analysis. Qualitative perception assessment revealed a few EP-analysis limitations in assessing perceptions. In fact, this tool has limited ability to assess perceptions which are not directly related to their previously defined essential concepts or which are difficult to measure, such as feelings and judgements (such as perceptions K, Q and U, Table III.2.3). Qualitative-based results also unravelled how knowledge and experience modulated community perceptions in Madeira, and even suggested its complex interplay, *i.e.,* why people perceived the reality in a particular manner (Figure III.2.4, Table III.2.2, and Table III.2.3). The performed focus group sessions (FGS) were, therefore, key in providing an extensive comprehension of cognitive and experience-based perceptions, which passed unnoticed in the EP-analysis perception assessment.

Due to its deepness qualitative perception assessment have also identified deep-beliefs, opinions, feelings and judgments. Based in this extensive data, qualitative overall perceptions assessment also suggested the presence of some attitudes and behaviours in community groups. Here the term attitudes is used as being «a permanent predisposition [versus temporary] to react in certain direction regardless the situation context» [181] and also «a tendency to react to external stimulus according to our own standards … determining behaviour, feelings and opinions» [182].

Models of behavioural change

Three perceptions are commonly proposed by several relevant models as being determinant for healthier decision-making: (i) the health susceptibility/severity (risk perception), the action-outcomes (response-expectancies) and the self-efficacy [145]. Results presented in this work are generally consistent with these models, since the three previous mentioned perceptions are covered by the overall perception model proposed. In fact, the first is related with 'Confusion in risk perception' theme, the second is related with 'domestic-source-reduction inefficacy' category and the third is related with 'domestic-source-reduction hard procedure' and 'domestic-source-reduction vain efforts' categories and with 'disbelief in water-related breeding sites' and 'non-recognition of *A. aegypti*'s domestic and urban attribute' sub-themes. Moreover, a higher similarity was found with both External Parallel Process model (EPPM) [67], and the Health Action Process Approach (HAPA) behaviour models [183]. The first suggests that individuals with an over-estimated risk will generate a precautionary motivation for protective behaviour (while those with an adequate risk perception will generate motivation for preventive ones). Consistently with the EPPM hypothesis, it is suggested that the more informed individuals were more likely to adhere to the proposed preventive behaviour (EPPM's danger control) and the ones who experienced a strong emotional stimulus, such as the extreme dengue health consequences, were the more likely to adhere to protective behaviour (EPPM's fear control) [67]. In the second case the interaction

between the three main perceptions assessed are in agreement with HAPA. In effect, results represented in the overall perception model assessed, 'risk perception' and 'action outcomes' can be considered 'self-efficacy' precursors, as stated in HAPA model [183].

Other perception assessments

Despite all the erroneous and the impairing perceptions assessed, when compared with similar studies using a descriptive-analysis methodology, Madeira community revealed a general level of awareness equivalent to or higher than what is observed in other dengue areas. An example is the comparison of the 8.3% of Chennai residents which agreed that «dengue mosquitoes breed in clean water» [179] and the 51.1% residents of a Pakistan city who stated that common breeding sites are in stagnant clean water [61], with the 95.5% of the Madeira residents who admitted «water-container to contribute for mosquito breeding» (all of them from areas where only one dengue outbreak has occurred). It is important to notice that, the descriptive analysis of non-standardized questions turns comparisons between different studies frequently unviable. Even though hard to compare this type of results suggest that Madeira has already come a long way to what was expected from a community who suffered a unique outbreak event and which is within a continent without reported dengue outbreaks for almost the last 100 years.

Perception re-assessment after the outbreak

The community perception assessment, before and after the outbreak, was exclusively performed through a quantitative data analysis. The EP-analysis was applied to a female population resident in the most-infested *aegypti* urban area in both the mentioned periods and the corresponding perceptions were quantitatively compared. The EP-analysis provided quantifiable results on perception differences between the two assessed periods. A statistically significant increase in the EP-score was observed. Moreover, due to their established theoretical assumptions, differences in the acknowledgement of specific concepts and topics were also measured,

identifying which of them had most increased after the outbreak experience.

The evolution of some perceptions (such as, the idea that the personality can protect from dengue sever forms, or that vaccine-based prevention could be implemented in Madeira) were not assessed since they were not covered by the essential concepts previously defined in the EP-analysis. Moreover, as FGS were performed exclusively after the outbreak, it was not possible to verify whether or not these perceptions were already present within the community before the outbreak had occurred or how they had evolved after it. However, results from the PRE-outbreak survey presented in sub-chapter II.2 have identified the presence of some perceptions, not assessed by EP-analysis (Table IV.1.1). In effect, «imported species», «generic water accumulation [such as, streams and tanks]», «absence of hygiene», «weather» and «empty houses or common lands» were examples of the resident's answer categories, when asked as open questions regarding «other factors or situations that promote mosquito breeding»[18]. These answers, given before the outbreak, are consistent with perceptions P, L, M, N and R assessed after the outbreak, suggesting their putative existence in the first period.

[18] apart from the multiple-choice options: plants, animals, food-debris or water containers

TABLE IV.1.1: CONSISTENCY IN THE PERCEPTION ASSESSED BY EP-ANALYSIS, OPEN-QUESTIONS AND FGS

ESSENTIAL TOPICS	ERRONEOUS /IMPAIRING PERCEPTIONS		EP-ANALYSIS		OPEN QUESTIONS	FGS
			PRE	POST		
MEDICAL IMPORTANCE	MYTH 1	'Mosquitoes do not transmit diseases'	√	√	-	-
	MYTH 2	'Mosquitoes only cause mild clinical consequences such as allergies, fever, etc.'	√	√	√	√
	A	' The nuisance resulted from a mosquito bite is a much dangerous than DF or the sole dangerous condition'	√	√	√	√
	B	'Dengue is like a treatable flu'	-	-	-	√
	C	'Dengue in Madeira won't have the same clinical consequences present in other countries '	-	-	-	√
	D	'The type of blood or eating can protect from mosquito bite'	-	-	-	√
	E	'Lack sensitivity to allergic reactions reveal an gained resistance to mosquito-borne diseases'	-	-	-	√
	F	'The type of diet determine whether dengue is or not transmitted during a mosquito bite'	-	-	-	√
	G	'Dengue severity is related to health status (*eg*. diabetes or asthma)'	-	-	-	√
	H	'Dengue severity is related personality and psychological stability'	-	-	-	√
	I	'DF/DHF resistance can be gained over time'	-	-	-	√
	J	'Dengue commonly provokes permanent severe health consequences (*eg*. lack of vision)'	-	-	-	√
LOCAL RISK	MYTH 3	'Dengue will not occur again in Madeira, it is very not likely'	-	√	-	-
	MYTH 4	'Since I do not feel the byte, I am not at risk of being bitten/infected'	√	√	-	√
	MYTH 5	'Mosquitoes are allocated in a specific area and are not able to spread through the island'	√	√	-	√
	MYTH 6	'Dengue/*A. aegypti* was, finally, eradicated'	-	√	-	-
DOMESTIC ATTRIBUTE	MYTH 7	'Local health authorities are the key intervenient in the control of mosquitoes'	√	√	√	√
	MYTH 8	'Insecticides or other protective measures can control mosquitoes'	√	√	-	√
	MYTH 9	'I am (Community is) not an intervenient in the *aegypti*-control'	√	√	√	√
	K	'Turnkey solutions *(eg.* vaccines) and vertical interventions (*eg*. governamental-based source reduction) are available and effective'	-	-	√	√
MOSQUITO BREEDING	L	'Natural large water collections are *A. aegypti*'s breeding sites (*e.g*. city streams)'	-	-	√	√
	M	'Public areas (both clean or dirty) have *A. aegypti*'s breeding sites (*eg.* lakes in gardens)'	-	-	√	√
	N	'Weather is the main determinant of mosquito population growth'	-	-	√	√

	MYTHS 10 AND 11	'Clean houses or houses without animals do not have mosquitoes' and/or 'People living in these houses have nothing to do concerning the control of mosquitoes'	√	√	√	√
	O	'Agricultural and small cattle environments induce mosquito breeding'	-	-	-	√
	P	'Mosquitoes don't derive from water'	-	-	√	√
CONTROL MEASURES	MYTH 12	'By the usage of insecticides and/or flyswatter, I am already contributing to the *aegypti*-control'	√	√	-	√
	Q	'Source reduction activities are ineffective'	√	√	-	√
	R	'Source reduction activities are hard to perform correctly'	-	-	-	√
	S	'Without policy and supervision in inhabited and non-inhabited areas, domestic *aegypti*-control is vain '	-	-	√	√
	T	'There are home-made solutions that effectively avoid mosquito breeding, biting or transmission'	-	-	√	√
(FEELINGS)	U	'Government was/is negligent regarding dengue prevention''	-	-	√	√
	V	'Dengue health risk could have been much divulged'	-	-	-	√

Cognitive and emotional dynamics

The effect of a dengue outbreak experience in the community perception was similar to what is described in other risk contexts. Studies after natural disasters (such as, earthquakes or floods) had shown two opposite effects of experience, which can result in either a perceived overestimation or underestimation of the probability of a recent event re-occurrence [157,158]. The former (commonly mentioned as 'availability bias') is known to be expected in individuals who feel fear. In the present work this was observed in those who heard about severe dengue health consequences and who perceived these events to be much more frequent than they are in reality. The latter is suggested, in the present work, to have occurred in individuals who believed in myth 3, which has this idea in its basis. Even though this myth was not observed in FGS results, it was suggested to be present in a maximum of 36.4% of the POST-outbreak surveyed population.

However, in contrast with what was described in natural disasters, dengue experience had also created a hasty generalization: - an inductive fallacy in

which conclusions are generalized without enough particular cases or evidence to support it. An example of this was the case of individuals who thought to be unsusceptible to mosquito bites and dengue on the basis of not having perceived these experiences yet. Other fallacies are the basis of several experience-derived conclusions, such as perceiving the dengue scenario in Madeira as non-lethal without considering further eventual severe dengue forms [184][185].

These fallacies were, on some level, expected since dengue provokes heterogeneous clinical features which are dynamic throughout the years. Therefore, a unique dengue outbreak is not enough to provide an adequate risk perception. Moreover, determinant factors for severe illness are still not well-understood and related research is neither abundant nor conclusive [186]. In all the above mentioned cases, past experiences led to a decrease in the precautionary motivation or in some cases an increase of this motivation but leading to protective behaviours (rather than the aimed preventive ones).

An experience-derived increase of motivation for preventive behaviours occurred, in some cases, only when the individual had some knowledge regarding the situation. This knowledge could have been gained through in several ways, such as: (i) outbreak extensive health-messages and information spread by authorities and media during the outbreak; (ii) the door-to-door interventions performed by expert authority personnel in the areas of higher prevalence; and (iii) word-of-mouth from individuals who travelled to or live/lived in dengue endemic countries (DEC).

Generally, the before and after outbreak results revealed that the dengue outbreak caused cognitive and emotional changes in public perception. In fact, and in agreement with other studies, both knowledge and experience regarding the proposed behaviour are thus required to achieve precautionary motivating perceptions. Individuals showing only one, out of these two factors were the ones less prone to adhere to the proposed behaviour. Analysing the several experiences assessed in this work, the one which had the highest effect in community perception was the experience of a dengue outbreak. Other experiences such as perceiving

mosquito bite (AME), having dengue and travelling to DEC, had less effect in community perception (Table IV.1.2).

TABLE IV.1.2: COMPARISON OF THE EFFECT OF SEVERAL DIFFERENT EXPERIENCES IN EP-SCORE

Experiencing a dengue outbreak in their city, having dengue, perceived mosquito bite (AME) or travelling to DEC.

	OUTBREAK*¥		DENGUE*		MOSQUITO BITE ¥		TRAVELLED TO DEC¥	
	PRE	POST	YES	NO	YES	NO	YES	NO
n individuals	88	88	7	81	887	293	287	876
EP-Score means	4.9	6.7	6.7	6.9	5.0	4.4	5.3	4.7
Differences in EP-Score means	1.9		0.2		0.6		0.6	

* Data from POST-outbreak survey

¥ Data from PRE-outbreak survey

LIMITATIONS

The unexpected emergence of a dengue outbreak one year after the beginning of the present work obviously altered the research direction, and added imperative and inevitable conditions to the research process.

In the second cross-sectional survey performed after the outbreak it was not possible to re-describe domestic breeding site present in the households, excluding both the infestation characterization and a measure of community's behaviours. Considering the studied sample, only women from urban areas were covered, and therefore results may not be equivalent in male subjects or rural communities.

The performed FGS have included male and female subjects. Although this may have led to some difficulties in the overall interpretation and had excluded a fully generalisation of the conclusions, it is believed that transparency and precision of the research has been enhanced rather than compromised. In effect, this flexibility was required to guarantee acceptance from the community, which in turns is vital for the conduction of a community-based study.

Ultimately these extreme conditions have provided gains for both community and the research process.

CONCLUSIONS

After nine years of contact with *A. aegypti*, subsequent to experiencing a dengue outbreak event, and followed with several preventive campaigns, Madeira's community has already gained dengue awareness regarding some relevant ideas commonly absent in long-term dengue communities. However, it not only lacked the knowledge required for the minimal understanding of the domestic source reduction behaviour, but also still did not intuitively perceive it as being needed, urgent, efficient, worth or fair.

Evidence was given suggesting an atypical infestation pattern of well-developed urban environments, raising questions regarding the commonly stated association between *aegypti*-infestation and the hygiene/water supply conditions.

The experience of a dengue outbreak have, by one hand, improved public perceptions, mainly regarding their cognitive clarification about domestic source reduction. But on the other hand it has also provided incomplete and ambiguous risk perception. Moreover, demotivation, disbelief and mistrust in the community are main perceptions observed among community after the outbreak. Other experiences, such as perceived mosquito bite (AME), allergies, dengue and travels to DEC were also shown to cause some behavioural impact.

As described in sub-chapters II.1 and III.2, the EP-analysis revealed to be an accurate methodology to assess public perceptions through questionnaire application. Furthermore, this tool also showed to be able to quantify in a standard manner differences in perceptions, which is of great value to monitor perception, compare groups of individuals, or to evaluate preventive campaigns. The essential concepts defined in EP-analysis' theoretical should be regularly complemented by asking open questions in surveys or by performing FGS. Campaigns should be hence, tailored according to their target community and to local entomological feature, and not simply "copied and pasted" from other dengue countries.

The present findings can contribute for turning the immense efforts and investments spent in dengue prevention campaigns worthy. They will undoubtedly contribute to attaining accurate public perceptions assessments and the development of adequate health messages, interventions and policies.

The planning and the performance of research studies in a dengue outbreak scenario, is methodologically challenging but provides unique knowledge and valuable lessons for both researches and public health experts.

LOCAL RECCOMENDATIONS

Based on the overall perception assessed, it is clear that the future dengue prevention campaigns need to not only improve their health messages content (to provide cognitive clarification), but also to implement some initiatives which may change public reality and therefore alter their intuitive/emotional perception. Examples of relevant priorities or measures which could strengthen community engagement are presented and discussed in the following paragraphs.

(1) Elucidate residents regarding the dengue health risks and

(2) Clarify the community about the availability and limitations of turnkey solutions and vertical interventions

An elucidation of DF/DHF health risks could be of great value to shape an adequate community's risk perception and, thus stimulate behaviour compliance (deriving from sub-chapter III.2 results, Pages 138-142). Moreover, clarification regarding both the unavailability of turnkey solutions (such as, vaccination or anti-viral therapy) and the limited reach of vertical interventions, will contribute to reinforce the relevance of community-based domestic source reduction (deriving from sub-chapter III.2 results, Page 149-150). Nevertheless, in order to guarantee health-messages efficacy in the domestic source reduction promotion, a balanced content is required (which alerts but does not frighten). In effect, if

provoking fear, health-messages would promote protective behaviours rather than preventives ones (see Pages 165 and 169).

(3) Visibly confirm larval forms in public and private areas

The last, and probably the sole representative entomological characterization was performed in 2011, within this study, and revealed flower-pot dishes to be the most frequent type of domestic breeding-site among households in the most infested areas. However, a potential evolution in the *A. aegypti* oviposition behaviour could have occurred due to the expectable intense control of domestic breeding sites during the outbreak. In effect, a lack of domestic breeding sites could have made *A. aegypti*' females lay eggs in other less common locations. A subsequent entomological survey is hence of great relevance to elucidate current *A. aegypti* breeding sites. The following putative breeding site should be explored in both domestic and public environments: (i) clean and dirty water accumulations, and (ii) artificial and (semi)-natural water-accumulations. In this way evidence would be provided to clarify whether or not the community's perceptions L[19] and O[20] (Table III.2.3, page 161) is actually true. Reports on *A. aegypti's* oviposition in all of these places can be found in the literature [178,149].

(4) Motivate domestic aegypti-control

This recommendation derive from sub-chapter III.2 results (Page 143-148) and could be achieved by several ways. Firstly, by increasing pragmatism of the behaviour proposals (*i.e.* prioritizing target breeding sites, clearly explaining how to correctly empty/wash/cover/eliminate them). Secondly, by considering feasibility of assigning responsibility to owners of infested properties (whether or not inhabited). Thirdly, by divulging local or international outcomes of domestic source reduction activities.

[19] «Natural large water collections are *A.aegypti*'s breeding sites (*eg*. city streams)»
[20] «Agricultural and small cattle environments induce mosquito breeding»

(5) Improve trust in the political entities.

The mistrust assessed in sub-chapter III.2 results (Page 149-150) would be probably indirectly improved with implementation of the previously described recommendations. Even though, for its full improvement it is also relevant that, whenever possible, uncertain issues (such as regarding DHF appearance in the Island) are assumed as such [187]. Moreover, the integration of the community in the planning and implementation of preventive interventions could promote the wanted cooperative feeling and in addition could also optimize resources and enrich the process. The divulgation of governmental mosquito-related initiatives and the considerations regarding its feasibility or effectiveness could also promote the same cooperative feeling.

In the date of this thesis print, some months have already passed since the end of the outbreak. Therefore some initiatives may have already been implemented and some of the described recommendations covered.

FUTURE PRESPECTIVES

Research regarding this subject is a continuous and never ending working in progress. Valuable next steps are:

- To design separate interventions which may concretize and evaluate the proposed local recommendations.
- To apply EP-analysis/FGS combined methodology in other dengue contexts, such as long-term endemic and epidemic regions, areas with co-existence of malaria and dengue, and *A. aegypti*'s non-infested areas, and compare results.
- To explore the effectiveness of hair dressers and pharmacies as selected locals for surveys performance in the health context.

Results gathered here may have also have pave the way for future lines of research regarding perception assessment in subjects far beyond dengue context but equally dependent on public perception for attaining a behavioral impact

REFERENCES

1. Lane RP, Crosskey, Roger W (Department of Entomology, The Natural History Museum LU, editors (1993) Medical Insects and arachnids. First edit. Chapman & Hall.

2. Macondes CB (n.d.) Generalidades e importância das doenças relacionada com artrópodes pp. 1–3.

3. Capinera J (2008) Encyclopedia of Entomology. Second edi. Springer.

4. Weaver SC, K RW (2010) Present and Future Arboriral Threaths. Antiviral Res 85: 1–36. doi:10.1016/j.antiviral.2009.10.008.Present.

5. Marquardt W (2010) Biology of disease vectors. Second Edi. Academic Press, Amsterdam.

6. Jansen CC, Beebe NW (2010) The dengue vector Aedes aegypti: what comes next. Microbes Infect 12: 272–279. Available: http://www.ncbi.nlm.nih.gov/pubmed/20096802. Accessed 5 February 2014.

7. Scott, Halstead B (International Vaccine Institute K (2008) Dengue. Tropical M. Pasvol G, Hoffman, Stephen L (Department of Infection & Tropical Medicine, Imperial College London U, editors Imperial College Press. Available: http://medcontent.metapress.com/index/A65RM03P4874243N.pdf. Accessed 14 March 2014.

8. Harrington LC, Scott TW, Lerdthusnee K, Coleman RC, Costero A, Clark GG, Jones JJ, Kitthawee S, Kittayapong P, Sithiprasasna R EJ (2005) Dispersal of the dengue vector Aedes aegypti within and between rural communities. Am J Trop Med Hyg 72: 209 – 220.

9. Wong J, Stoddard S, Astete H, Morrison A, Scott T (2011) Oviposition Site Selection by the Dengue Vector Aedes aegypti and Its Implications for Dengue Control. PLoS Negl Trop Dis 5: e1015.

10. Donalísio M, Glasser C (2002) Vigilância entomológica e controle de vectores do dengue. Rev Bras Epidemiol 5: 259–279.

11. Encyplopedia Britannica (n.d.). Available: http://www.britannica.com/. Accessed 12 February 2014.

12. Lounibos L (2002) Invasions by insect vectors of human disease. Annu Rev Entomol 47: 233–266.

13. Simmons CP, Farrar JJ, Chau NVV, Wills B (2012) Dengue. N Engl J Med 366.

14. Paupy C, Delatte H, Bagny L, Corbel V, Fontenille D (2009) Aedes albopictus, an arbovirus vector: from the darkness to the light. Microbes Infect 11: 1177–1185. Available: http://www.ncbi.nlm.nih.gov/pubmed/19450706. Accessed 27 February 2014.

15. Monath TP (2007) Dengue and Yellow Fever - Challenges for the Development and Use of Vaccines. N Engl J Med 357: 2222–2225.

16. Monath TP (2001) Yellow fever : an update. LANCET Infect Dis 1: 11–20.

17. Robinson M (1955) An epidemic of virus disease in Southern Province, Tanganyika Territory, in 1952-1953. Trans R Soc Trop Med Hyg 49: 28–32.

18. World Health Organization (WHO) (n.d.) Chikungunya. Available: http://www.who.int/mediacentre/factsheets/fs327/en/. Accessed 31 March 2014.

19. Van den Hurk AF, Hall-Mendelin S, Pyke AT, Frentiu FD, McElroy K, et al. (2012) Impact of Wolbachia on infection with chikungunya and yellow fever viruses in the mosquito vector Aedes aegypti. PLoS Negl Trop Dis 6: e1892. Available: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3486898&tool=pmcentrez&rendertype=abstract. Accessed 28 February 2014.

20. Ledrans M, Quatresous I, Renault P, Pierre V (2007) Outbreak of chikungunya in the French Territories, 2006: lessons learned. Euro Surveill 12. Available: http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=3262.

21. Murray NEA, Wilder-Smith MBQ (2013) Epidemiology of dengue : past , present and future prospects. Clin Epidemiol 5: 299–309.

22. Normille D (2013) Surprising New Dengue Virus Throws A Spanner in Disease Control Efforts.

23. CDC - Symtops & Treatment - Dengue (n.d.). Available: http://www.cdc.gov/dengue/Symptoms/.

24. WHO | Dengue (n.d.). Available: http://www.who.int/topics/dengue/en/.

25. Bhatt S, Gething PW, Brady OJ, Messina JP, Farlow AW, et al. (2013) The global distribution and burden of dengue. Nature 496: 504–507. Available: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3651993&tool=pmcentrez&rendertype=abstract. Accessed 23 February 2014.

26. Hammond S, Balmaseda A, Pérez L, Tellez Y, Sabiorío S, et al. (2005) Differences in dengue severity in infants, children, and adults in 3-year-hospital-based study in Nicaragua. Am J Trop Med Hyg 73: 1063–1070.

27. Shepard D, Coudeville L, Halasa Y, Zambrano B, Dayan G (2011) Economic impact of dengue illness in the Americas. Am J Trop Med Hyg 84: 200–207.

28. Shepard D, Undurraga E, Halasa Y (2013) Economic and disease burden of dengue in Southeast Asia. PLoS Negl Trop Dis 7: e2055.

29. Suaya J a, Shepard DS, Siqueira JB, Martelli CT, Lum LCS, et al. (2009) Cost of dengue cases in eight countries in the Americas and Asia: a prospective study. Am J Trop Med Hyg 80: 846–855. Available: http://www.ncbi.nlm.nih.gov/pubmed/19407136.

30. Hotez P, Fenwick A, Savioli L, Molyneux D (2009) Rescuing the bottom billion through control of neglected tropical diseases. Lancet 373.

31. Margarita Y, Santos Grácio A, Lencastre L, AC S, Novo T, et al. (2006) First record of Aedes (Stegomyia) aegypti (Linnaeus, 1762) (Diptera, Culicidae) in Madeira Island – Portugal (Portuguese, English abstract). Acta Parasitológica Port 13: 59–61.

32. Capela R (1981) Contribution to the study of mosquitoes (Diptera, Culicidae) from the Archipelagos of Madeira and the Salvages. I – Madeira. , vol. I, pp.. Arq do Mus Bocage (Série A) I: 45–66.

33. Gonçalves Y, Silva J, Biscoito M (2008) On the presence of Aedes (Stegomya) aegypti Linnaeus, 1762 (Insecta, Diptera, Culicidae) in the island of Madeira (Portugal). Bol do Mus Munic do Funchal 58: 53–59.

34. Almeida A, Gonçalves Y, Novo M, Sousa C, Melim M, et al. (2007) Vector monitoring of Aedes aegypti in the Autonomous Region of Madeira, Portugal. Eurosurveillance 12: 3311.

35. Rosen L (1986) Dengue in Greece in 1927 and 1928 and the pathogenesis of dengue hemorrhagic fever: new data and a different conclusion. Am J Trop Med Hyg 35: 642–653.

36. Direcção Geral de Saúde M da S (Portugal) (2013) Surto de dengue na Ilha da Madeira - situação em 3 de março de 2013 (dengue outbreak in Madeira island, update at 3rd March, 2013).

37. Direcção Regional de estatística, Funchal M (Portugal) (2012) Anuário estatístico da região Autónoma da Madeira.

38. Wilder-Smith A, Quam M, Sessions O, Rocklov J, Liu-Helmersson J, et al. (2014) The 2012 dengue outbreak in Madeira: exploring the origins. Euro Surveill Bull Eur sur les Mal Transm = Eur Commun Dis Bull Commun Dis Bull 19: 20718. Available: http://www.ncbi.nlm.nih.gov/pubmed/24602277.

39. Rezza G (2012) Aedes albopictus and the reemergence of Dengue. BMC Public Health 12: 72. Available: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3398301&tool=pmcentrez&rendertype=abstract. Accessed 14 March 2014.

40. ECDC Aedes aegypti (n.d.). Available: http://www.ecdc.europa.eu/en/healthtopics/vectors/mosquitoes/Pages/aedes-aegypti.aspx.

41. Medlock JM, Hansford KM, Schaffner F, Versteirt V, Van Bortel W, et al. (2012) A Review of the Invasive Mosquitoes in Europe : Vector-Borne Zoonotic Dis 12. doi:10.1089/vbz.2011.0814.

42. ECDC Vbornet Mosquito map (n.d.). Available: http://www.ecdc.europa.eu/en/healthtopics/vectors/vector-maps/Pages/VBORNET_maps.aspx.

43. Gubler DJ (2004) The changing epidemiology of yellow fever and dengue, 1900 to 2003: full circle? Comp Immunol Microbiol Infect Dis 27: 319–330. Available: http://www.ncbi.nlm.nih.gov/pubmed/15225982. Accessed 27 January 2014.

44. Brathwaite Dick O, San Martín JL, Montoya RH, del Diego J, Zambrano B, et al. (2012) The history of dengue outbreaks in the Americas. Am J Trop Med Hyg 87: 584–593. Available: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3516305&tool=pmcentrez&rendertype=abstract. Accessed 22 January 2014.

45. Schliessman D, Calheiros L (1974) A review of the status of yellow fever and Aedes aegypti erradication programs in the Americas. Mosq News 34: 1–9.

46. Reiter P (2001) Climate change and mosquito-borne disease. Environ Health Perspect 109 Suppl : 141–161. Available: http://www.ncbi.nlm.nih.gov/pubmed/18819667.

47. Guzmán MG, Kourí G, Morier L FA (1984) A study of fatal hemorrhagic dengue cases in Cuba 1981. Bulletín PAHO 18: 213–220.

48. Watson R, Zinyowera M, Moss R (1998) The Regional Impacts of Climate Change: An Assessment of Vulnerability. Special Report of the Intergovernmental Panel on Climate Change (IPCC) Working Group II. Cambridge:

49. McMichae A, Haines A, Slooff R, Kovats S (Geneva:World HO (WHO)) (1996) Climate Change and Human Health.

50. Capinha C, Rocha J, Sousa C a (2014) Macroclimate Determines the Global Range Limit of Aedes aegypti. Ecohealth. Available: http://www.ncbi.nlm.nih.gov/pubmed/24643859. Accessed 20 March 2014.

51. Anderson R (1984) Health Promotion: an overview. Eur Mnographs Heal Educ Res 6.

52. Bunton R, Macdonald G, editors (2002) Health Promotion: Disciplines, Diversity, and Development. second edi. Routledge.

53. Lalonde, M (Ottawa CI (1974) A new prespective on the health of Canadians: a working document.

54. The Ottawa Charter for Health Promotion. First International Conference on Health Promotion (1986).

55. Scott D, Weston R, editors (1998) Planning and evaluating. Evaluating health Promotion. (Oxford press) springer. pp. 92–107.

56. World Health Organization (WHO) (1998) Health Promotion Glossary.

57. Sørensen K, Van den Broucke S, Fullam J, Doyle G, Pelikan J, et al. (2012) Health literacy and public health: a systematic review and integration of definitions and models. BMC Public Health 12: 80. Available: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3292515&tool=pmcentrez&rendertype=abstract. Accessed 27 March 2014.

58. World Health Organization (WHO) (2001) Evaluation in Health Promotion - Principles and prespectives. Rootman I, Goodstadt M, Hynman B, McQueen D V, Potvin L, et al., editors Denmark: World Health Organization Regional Publications.

59. Blaxter M (1990) Health and lifestyles. London: Routledge.

60. Dahlgren G, Whitehead M (1991) Policies and strategies to promote social equity in health.

61. Itrat A, Khan A, Javaid S, Kamal M, Khan H, et al. (2008) Knowledge, awareness and practices regarding dengue fever among the adult population of dengue hit cosmopolitan. PLoS One 3: e2620. Available: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2440812&tool=pmcentrez&rendertype=abstract. Accessed 24 April 2014.

62. Quintero J, Carrasquilla G, Suárez R, González C, Olano VA (2009) An ecosystemic approach to evaluating ecological , socioeconomic and group dynamics affecting the prevalence of Aedes aegypti in two Colombian towns Aproximación ecosistémica para evaluar las relaciones entre ecología , factores socioeconómicos , dinámica. Cad Saude Publica 25: 93–103.

63. Frankel S, Davison C, Smith GD (1991) Lay epidemiology and the rationality of responses to health education. Br J Gen Pract 41: 428–430. Available: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1371828&tool=pmcentrez&rendertype=abstract.

64. Rosenstock IM (1974) Historical origins of the health belief mode. Health Educ Monogr 2: 328–335.

65. Bandura A (1986) Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, editor NJ, US: National Inst of Mental Health Rockville MD US. Available: http://psycnet.apa.org/psycinfo/1985-98423-000.

66. Rosenstock IM, Strecher VJ, Becker MH (1988) Social learning theory and the Health Belief Model. Health Educ Q 15: 175–183. Available: http://www.ncbi.nlm.nih.gov/pubmed/3378902.

67. Witte K (1994) Fear control and danger control: A test of the extended parallel process mode. Commun Monogr 61: 113–134. Available: http://www.tandfonline.com/doi/abs/10.1080/03637759409376328#preview.

68. Schwarzer R (1992) Self-efficacy in the adoption and maintenance of health behaviors: Theoretical approaches and a new model. In: Schwarzer R, editor. Self-efficacy: Thought control of action. Washington, DC: Hemisphere. pp. 217–243.

69. Slovic P (1987) Perception of Risk. Sci New Ser 236: 280–285.

70. Conner M, Sparks P (1996) The theory of planned behaviour and health behaviours. In: Conner M, Norman P, editors. Predicting health behaviour. Buckingham, UK: Open University Press. pp. 121 – 162.

71. Slovic P, Finucane ML, Peters E, MacGregor DG (2004) Risk as analysis and risk as feelings: some thoughts about affect, reason, risk, and rationality. Risk Anal 24: 311–322. Available: http://www.ncbi.nlm.nih.gov/pubmed/15078302.

72. Mellers BA, Schwartz A, Ho K, Ritov I (1997) Decision Affect Theory: Emotional Reactions to the Outcomes of Risky Options. Psychol Sci 8: 423–429.

73. Bechara A, Damasio AR (2005) The somatic marker hypothesis : A neural theory of economic decision. Games Econ Behav 52: 336–372. doi:10.1016/j.geb.2004.06.010.

74. Isa A, Loke YK, Smith JR, Papageorgiou A, Hunter PR (2013) Mediational effects of self-efficacy dimensions in the relationship between knowledge of dengue and dengue preventive behaviour with respect to control of dengue outbreaks: a structural equation model of a cross-sectional survey. PLoS Negl Trop Dis 7: e2401. Available: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3784466&tool=pmcentrez&rendertype=abstract. Accessed 28 January 2014.

75. Tsuzuki A, Huynh T, Tsunoda T, Luu L, Kawada H, et al. (2009) Effect of Existing Practices on Reducing Aedes aegypti Pre-adults in Key Breeding Containers in Ho Chi Minh City, Vietnam. Am J Trop Med Hyg 80: 752– 757.

76. Hibbard JH, Slovic P, Peters E, Finucane ML (2002) Strategies for Reporting Health Plan Performance Information to Consumers : Evidence from Controlled Studies. HSR Heal Serv Res 37: 291–313.

77. Dowler E, Green J, Bauer M, Gasperoni G (2006) Assessing public perception: issues and methods. In: Carlos D, editor. Health, hazard and public debate: lessons for risk communication from the BSE/CJD saga. Geneva: World Health Organization. pp. 40–60. Available: http://www.waterstones.com/waterstonesweb/advanced...

78. Tones B, Tilford S (1994) Health Promotion: Effectiveness, Efficiency and Equity. Chapman & Hall, London.

79. Seidman I (2006) Interviewing. New York: Teachers College Press.

80. Teddie C, Tashakkori A (2009) Foundations of Mixed Methods Research. Thousand oaks, California: Sage publications.

81. De Ketele J-M, Roegiers X (1993) Méthodologie du recueil d'informations. Lisbon: Instituto Piaget.

82. Schuman H, Presser S (1979) The open and closed question. Am Sociol Rev 44: 692–712.

83. Foddy W (2002) Constructing questions for interviews and Questionnaires: Teory and Practice in Social Research.

84. Hill MM, Hill A (n.d.) Investigação por questionário. 2nd editio. Robalo M, editor Lisboa: Edições Sílabo.

85. Ressel LB, Lúcia C, Beck C, Maria D, Gualda R, et al. (2008) O uso do grupo focal em pesquisa qualitativa.

86. Westphal M, Bogus C, Faria M de M (1996) Grupos focais: experiências precursoras em programas educativos em saúde no Brasil. Bol Of Saint Panam 120: 472–481.

87. Chiesa AM, Ciampone MHT (1999) Princípios gerais para a abordagem de variáveis qualitativas e o emprego da metodologia de grupos focais (A classificação internacional das práticas de enfermagem em saúde coletiva – CIPESC). Brasília.

88. Meier M, Kudlowiex S (2003) Grupo focal: uma experiência singular. Texto Context En 12: 394–399.

89. Kitzinger J (1995) Introducing focus groups. BMJ Open 311: 299–302.

90. Webb C, Kevern J (2001) Focus groups as a research method: a critique of some aspects of their use in nursing research. J Adv Nurs 33: 798–805.

91. Braun V, Clarke V (2006) Using thematic analysis in psychology. Qual Res Psychol 3: 77–101. Available: http://www.tandfonline.com/doi/abs/10.1191/1478088706qp063oa.

92. Holloway I, Todres L (2003) The status of method: flexibility, consistency and coherence. Qual Res 3: 345–357.

93. Vaismoradi M, Turunen H, Bondas T (2013) Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. Nurs Health Sci 15: 398–405. Available: http://www.ncbi.nlm.nih.gov/pubmed/23480423. Accessed 21 March 2014.

94. Israel B a, Schulz a J, Parker E a, Becker a B (1998) Review of community-based research: assessing partnership approaches to improve public health.

Annu Rev Public Health 19: 173–202. Available: http://www.ncbi.nlm.nih.gov/pubmed/9611617.

95. Israel B a., Parker E a., Rowe Z, Salvatore A, Minkler M, et al. (2005) Community-Based Participatory Research: Lessons Learned from the Centers for Children's Environmental Health and Disease Prevention Research. Environ Health Perspect 113: 1463–1471. Available: http://www.ehponline.org/ambra-doi-resolver/10.1289/ehp.7675. Accessed 19 March 2014.

96. Heron J, Reason P (2001) The practice of co-operative inquiry: Research "with" rather than "on" people. In: Reason P, Bradbury H, editors. Handbook of action research: Participative inquiry and practice. London: Sage publications. pp. 179–188.

97. Kemmis S, McTaggart R (2000) Participatory action research. In: Handbook of Qualitative Research. Denzin N, Lincoln Y, editors Thousand oaks, California: Sage publications.

98. O'Fallon L, Tyson F, Dearry A (2000) Improving public health through community-based participatory research and education. Env Epidemiol Toxicol 2: 201–209.

99. World Health Organization (WHO) - Communicable Diseases (CDS) Division WHO Mediterranean Centre for Vulnerability Reduction (2006) Manual for Planning Communication-for-Behavioural-Impact-(COMBI) Programmes for Health. Geneva/Tunis.

100. Green L, Kreuter M (1991) Health Promotion Planning: An Educational and Environmental Approach. Second edi. Mountain View, CA: Mayfield Publishing Company.

101. Nitcher M (1993) Social Science lessons from diarrhoea research and their application to ARI. Hum Organ 52: 53–67.

102. Yoder P (1997) Negotiating relevance: belief, knowledge and practice in international health projects. Med Anthropol Q 11: 131–146.

103. Setbon M, Raude J (2009) Population response to the risk of vector-borne diseases: lessons learned from socio-behavioural research during large-scale outbreaks. Emerg Health Threats J 2: e6. Available: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3167643&tool=pmcentrez&rendertype=abstract. Accessed 31 January 2014.

104. Sperber D (1997) Intuitive and Reflective Beliefs. Mind Lang 12: 67–83. Available: http://www.blackwell-synergy.com/links/doi/10.1111%2F1468-0017.00036.

105. Weiss MG (2001) Cultural epidemiology: An introduction and overview. Anthropol Med 8: 5–29. Available: http://www.tandfonline.com/doi/abs/10.1080/13648470120070980. Accessed 27 April 2014.

106. Parks W, Lloyd L (2004) Planning social mobilization and communication for dengue prevention and control - a step-by-step guide. Ciceri K, editor China.

107. Renganathan E, Parks W, Lloyd L, Nathan MB, Hosein E, et al. (2003) Towards Sustaining Behavioural Impact in Dengue Prevention and Control. Dengue Bulletín 27: 6–12.

108. Organización Panamericana de la Salud (2011) Sistematización de lecciones aprendidas en proyectos COMBI en dengue en la región de las Américas. San Martín JL, Lloyd L, Montoya RH, del Diego J, editors Grupo Gráfico GLO.

109. Rozhan S, Jamsiah M, Rahimah A, Ang K (2006) The COMBI (Communication for Behavioural Impact) in the Prevention and Control of Dengue-The Hulu Langat Experience. J Community Health 12: 19–32.

110. Gubler D (2011) Prevention nd control of Aees aegypti-borne diseases: Lessons learned from past successes and failures. Asian-Pacific J Mol Biol abd Biotechnol 19.

111. Brathwaite Dick O, San Martín JL, Montoya RH, del Diego J, Zambrano B, et al. (2012) The history of dengue outbreaks in the Americas. Am J Trop Med Hyg 87: 584–593. Available: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3516305&tool=pmcentrez&rendertype=abstract. Accessed 22 January 2014.

112. Gubler D, Clark GG (1996) Community involvement in the control of Aedes aegypti. Acta Trop 61: 169–179.

113. McCall P, Kittayapong K (2007) Control of dengue vectors tools and strategies.

114. Vontas J, Kioulos E, Pavlidi N, Morou E, della Torre a., et al. (2012) Insecticide resistance in the major dengue vectors Aedes albopictus and Aedes aegypti. Pestic Biochem Physiol 104: 126–131. Available: http://linkinghub.elsevier.com/retrieve/pii/S0048357512000818. Accessed 27 April 2014.

115. Pavão AC, Leâo M (2005) Riscos de carcinogénese química no controle de Aedes aegypti. In: Silva Augusto LG da, Carneiro RM, Martins PH, editors. Abordagem ecossistêmica em saúde - ensaios para o controle da dengue. Editora universitária UFPE. pp. 213–225.

116. World Health Organization (WHO) - global malaria programme (2011) The use of DDT in malaria vector control - WHO position statement.

117. Kay B, Vu S (2005) New startegy against Aedes aegypti in Vietnam. Lancet 365: 613–617.

118. Darriet F, Marcombe S, Etienne M, Yébakima A, Agnew P, et al. (2010) Field evaluation of pyriproxyfen and spinosad mixture for the control of insecticide resistant Aedes aegypti in Martinique (French West Indies). Parasit Vectors 3: 88. Available:

http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2945330&tool=pmcentrez&rendertype=abstract.

119. Marcombe S, Darriet F, Agnew P, Etienne M, Yp-Tcha M-M, et al. (2011) Field efficacy of new larvicide products for control of multi-resistant Aedes aegypti populations in Martinique (French West Indies). Am J Trop Med Hyg 84: 118–126. Available: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3005507&tool=pmcentrez&rendertype=abstract. Accessed 27 April 2014.

120. Alphey L, Benedict M, Bellini R, Clark GG, Dame D, et al. (2010) Sterile-insect methods for control of mosquito -borne diseases - an analysis. Vector-Borne Zoonotic Dis 10: 295–311.

121. Wise de Valdez M (2011) Genetic elimination of dengue vector mosquitoes. Proc Nationl Acad Sci 108: 4772–4775.

122. Yin Z, Chen Y-L, Schul W, Wang Q-Y, Gu F, et al. (2010) An adenosine nucleoside inhibitor of dengue virus PNAS 2009 106 (48) 20435-20439; published ahead of print November 16, 2009, doi:10.1073/pnas.0907010106An adenosine nucleoside inhibitor of dengue virus. Curr Infect Dis Rep 12: 157–164.

123. Wilder-Smith A, Ooi E-E, Vasudevan SG, Gubler DJ (2010) Update on dengue: epidemiology, virus evolution, antiviral drugs, and vaccine development. Curr Infect Reports 12: 157–164.

124. World Health Organization (WHO) (2012) Global strategy for dengue prevention and control 2012-2020. Geneva.

125. Creswell J, Plano Clark V, Gutmann M, Hanson W (2003) Advanced mixed methods research designs. In: Tashakkori A, Teddlie C, editors. Handbook of mixed methods in social and behavioral research. Thousand oaks, California: Sage publications. pp. 209–240.

126. Stahl H, Butenschön VM (2013) Cost of dengue outbreaks : literature review and country case studies. BMC Public Health 13: 1048. Available: http://www.biomedcentral.com/content/pdf/1471-2458-13-1048.pdf.

127. World Health Organization (WHO) (2010) Working to overcome the global impact of neglected tropical diseases.

128. Winch P, Kendall C, Gubler D (1992) Effectiveness of community participation in vector-borne disease control PETER WINCH1, CARL KENDALL1 and DUANE GUBLER2. Health Policy Plan 7: 342–351.

129. Chinnakali P, Gurnani N, Upadhyay RP, Parmar K, Suri TM, et al. (2012) High Level of Awareness but Poor Practices Regarding Dengue Fever Control: A Cross-sectional Study from North India. N Am J Med Sci 4: 278–282. Available: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3385365&tool=pmcentrez&rendertype=abstract. Accessed 26 April 2014.

130. Vanlerberghe V, Rodrıguez M, Gomez D, Baly A, Benitez J, et al. (2009) Community involvement in dengue vector control : cluster randomised trial. BMJ 338: b1959. doi:10.1136/bmj.b1959.

131. Winch PJ, Leontsini E, Rigau-Pérez JG, Ruiz-Pérez M, Clark GG, et al. (2002) Community-based dengue prevention programs in Puerto Rico: impact on knowledge, behavior, and residential mosquito infestation. Am J Trop Med Hyg 67: 363–370. Available: http://www.ncbi.nlm.nih.gov/pubmed/12452490.

132. Series H and ELP (n.d.) Better environmental management for control of dengue. Available: http://www.who.int/heli/risks/vectors/denguecontrol/en/#.

133. Reidpath DD, Allotey P, Pokhrel S (2011) Social sciences research in neglected tropical diseases 2: A bibliographic analysis. Health Res Policy Syst 9: 1. Available: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3024304&tool=pmcentrez&rendertype=abstract. Accessed 27 April 2014.

134. Koenraadt CJM, Tuiten W, Sithiprasasna R, Kijchalao U, Jones JW, et al. (2006) Dengue knowledge and practices and their impact on Aedes aegypti populations in Kamphaeng Phet, Thailand. Am J Trop Med Hyg 74: 692–700. Available: http://www.ncbi.nlm.nih.gov/pubmed/16607007.

135. Launiala A (2009) How much can a KAP survey tell us about people's knowledge, attitudes and practices? Some observations from medical anthropology research on malaria in pregnancy in Malawi. Anthropol matters 11.

136. Hausmann-muela S, Ribera JM, Nyamongo I (2003) Health-seeking behaviour and the health system response.

137. Gubler DJ (1998) Dengue and dengue hemorrhagic fever. Clin Microbiol Rev 11: 480–496. Available: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=88892&tool=pmcentrez&rendertype=abstract.

138. Seixas G (2012) Aedes (Stegomyia) aegypti (Diptera, Culicidae) from Madeira Island: geographical origin and insecticide resistance Universidade Nova de Lisboa.

139. Sousa C a, Clairouin M, Seixas G, Viveiros B, Novo MT, et al. (2012) Ongoing outbreak of dengue type 1 in the Autonomous Region of Madeira, Portugal: preliminary report. Euro Surveill 17: 8–11. Available: http://www.ncbi.nlm.nih.gov/pubmed/23231893.

140. European Centre for Disease prevention and Control (ECDC) (2013) Communicable disease threats (week 2, 6-12 January 2013). Stockholm.

141. Gould E a, Gallian P, De Lamballerie X, Charrel RN (2010) First cases of autochthonous dengue fever and chikungunya fever in France: from bad

dream to reality! Clin Microbiol Infect 16: 1702–1704. Available: http://www.ncbi.nlm.nih.gov/pubmed/21040155.

142. Wright WF, Pritt BS (2012) Update: The diagnosis and management of dengue virus infection in North America. Diagn Microbiol Infect Dis 73: 215–220. Available: http://www.ncbi.nlm.nih.gov/pubmed/22541792. Accessed 21 March 2014.

143. Rogers DJ (2012) The climatic suitability for dengue transmission in continental Europe. Stockholm.

144. Direcção Regional de Estatística (2011) CENSOS 2011 Resultados Preliminares Região Autónoma da Madeira.

145. Armitage CJ, Conner M (2007) Social cognition models and health behaviour : A structured review: 37–41.

146. Pelto PJ, Pelto GH (1997) Studying knowledge, culture, and behavior in applied medical anthropology. Med Anthropol Q 11: 147–163. Available: http://www.ncbi.nlm.nih.gov/pubmed/9186958.

147. Kirkby K, Galappaththy G, Kurinczuk J, Rajapakse S, Fernando S (2013) Knowledge, attitudes and practices relevant to malaria elimination amongst resettled populations in a post-conflict district of northern Sri Lanka. Trans R Soc Trop Med Hyg 107: 110–118.

148. Rosenbaum J, Nathan M, Ragoonanansingh R, Rawlins S, Gayle C, et al. (1995) Community participation in dengue prevention and control: a survey of knowledge, attitudes, and practice inTrinidad and Tobago. Am J Trop Med Hyg 53: 111–117.

149. Burkot T, Handzel T, Schmaedick M, Tufa J, Roberts J, et al. (2007) Productivity of natural and artificial containers for Aedes polynesiensis and Aedes aegypti in four American Samoan villages. Med Vet Entomol 21: 22–29.

150. Medronho R a, Macrini L, Novellino DM, Lagrotta MTF, Câmara VM, et al. (2009) Aedes aegypti immature forms distribution according to type of breeding site. Am J Trop Med Hyg 80: 401–404. Available: http://www.ncbi.nlm.nih.gov/pubmed/19270289.

151. Bagny L, Delatte H, Elissa N, Quilici S, Bagny LA (2009) Aedes (Diptera : Culicidae) Vectors of Arboviruses in Mayotte (Indian Ocean): Distribution Area and Larval Habitats Aedes (Diptera : Culicidae) Vectors of Arboviruses in Mayotte (Indian Ocean): Distribution Area and Larval Habitats. J Med Entomol 46: 198–207.

152. Espinoza-Gómez F, Hernández-Suárez MC, Coll-Cárdenas R (2002) Educational campaign versus malathion spraying for the control of Aedes aegypti in Colima, Mexico. J Epidemiol Community Heal 56: 148–152.

153. Dégallier N, Vilarinhos P, de Carvalho M, Knox M, Caetano JJ (2000) People's knowledge and practice about dengue, its vectors, and control means in

Brasilia (DF), Brazil: its relevance with entomological factors. J Am Mosq Control Assoc 16: 114–123.

154. BBC News (2013). Available: http://www.bbc.co.uk/news/world-latin-america-21115216,.

155. Schwartz E, Meltzer E, Mendelson M, Tooke A, Steiner F, et al. (2013) Detection on four continents of Dengue fever cases related to an ongoing outbreak in Luanda, Angola, March to May 2013. Euro Surveill 18.

156. Centres for Disease Control and prevention (CDC) (n.d.) Neglected Tropical Diseases. Available: http://www.cdc.gov/globalhealth/ntd/.

157. Fernando SD, Paranavitane S, Galappaththy GNL (2011) Malaria is an Important Differential Diagnosis in Visitors Returning from Sri Lankan National Safari Parks. 18: 361–362. doi:10.1186/1475-2875-2-22.7.

158. World Health Organization (WHO) (2013) The top 10 causes of death: Fact sheet N°310. Available: http://who.int/mediacentre/factsheets/fs310/en/index.html.

159. Cohen M, Etner J (2008) Dynamic Decision Making when Risk Perception depends on Past Experience ∗. Theory Decis 64: 173–192.

160. Barnett J, Breakwell GM (2001) Risk Perception and Experience : Hazard Personality Profiles and Individual Differences. Risk Anal 21.

161. Kunreuther H (1996) Mitigating Disaster Losses through Insurance. J Risk Uncertain 12: 171–187.

162. Browne MJ, Hoyt RE (2000) The Demand for Flood Insurance : Empirical Evidence. J Risk Unceirtainty 20: 291–306.

163. Kahneman D, Tversky A (1979) Prospect Theory: An Analysis od Decision under Risk. Econometrica 47: 263–292.

164. McClelland GH, Schulze WD, Coursey DL (1993) Insurance for low-probability hazards: A bimodal response to unlikely events. J Risk Uncertain 7: 95–116. Available: http://link.springer.com/10.1007/BF01065317.

165. Papon T (2004) L'influence de la durée d'engagement et du vécu dans les décisions d'assurance: deux études expérimentales. Cah la MSE 40.

166. Nazareth T, Teodósio R, Porto G, Gonçalves L, Seixas G, et al. (2014) Strengthening the perception-assessment tools for dengue prevention: a cross-sectional survey in a temperate region (Madeira, Portugal). BMC Public Health 14: 39. Available: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3905660&tool=pmcentrez&rendertype=abstract.

167. Incidencia Dg 2012 (n.d.).

168. Sergeant E, Disease AAHS and ABCRC for EI (n.d.) Epitools epidemiological calculators/ Sample size to detect a significant difference between 2 means with equal sample sizes and variances. 2014. Available: http://epitools.ausvet.com.au.

169. Addelman S (1970) Variability of treatments and experimental units in the design and analysis of experiment. J Am Stat Assoc 65: 1095–1108. Available: http://ainfo.cnptia.embrapa.br/digital/bitstream/item/88802/1/Variability-treatments.pdf.

170. Hintze J (2014) PASS 13. NCSS, LLC.

171. Faul F, Erdfelder E, Lang A-G, Buchner A (2007) G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behav Res Methods 39: 175–191. Available: http://www.ncbi.nlm.nih.gov/pubmed/17695343.

172. Rosen L (1986) Dengue in Greece in 1927 and 1928 and the Pathogenesis of Dengue Hemorrhagic Fever: New Data and a Different Conclusion. Am J Trop Med Hyg 35: 642–653.

173. Fallon LRO, Dearry A (2002) Community-Based Participatory Research as a Tool to Advance Environmental Health Sciences. Environ Health Perspect 110: 155–159.

174. Hesse-Biber SN, Leavy P (2011) The practice of qualitative research. Second edi. Tasch J, Virding A, Dodd A, Habib L, Knight V, editors Thousand oaks, California: Sage publications.

175. Green L, Kreuter M (1991) Health promotion planning: An educational and environmental approach. 2nd edition. : Mayfield Publishing Company. 2th ed.

176. Neergaard M, Olesen F, Andersen R, Sondergaard J (2009) Qualitative description - the poor cousin of health research? BMC Res Methodol 16: 52.

177. Ruiter RA, Abraham C, Kok G (2001) Scary warnings and rational precautions: a review of the psychology of fear appeals. Psychol Heal 16: 613–630.

178. Arunachalam N, Tana S, Espino F, Kittayapong P, Abeyewickreme W, et al. (2010) Eco-bio-social determinants of dengue vector breeding: a multicountry study in urban and periurban Asia. Bull World Health Organ 88: 173–184. Available: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2828788&tool=pmcentrez&rendertype=abstract. Accessed 20 March 2014.

179. Ashok Kumar V, Rajendran R, Manavalan R, Tewari SC, Arunachalam N, et al. (2010) Studies on community knowledge and behavior following a dengue epidemic in Chennai city, Tamil Nadu, India. Trop Biomed 27: 330–336. Available: http://www.ncbi.nlm.nih.gov/pubmed/20962733.

180. Sperber D (2009) Culturally transmitted misbeliefs. Behav Brain Sci 32: 534. Available: http://www.journals.cambridge.org/abstract_S0140525X09991348. Accessed 14 March 2014.

181. Gauquelin M, Gauquelin F, Akoun A, Amar A, Chauchard P, et al. (1978) Dicionário de Psicologia. verbo.

182. Imperatori E (1999) Mais de 1001 conceitos para melhorar a qualidade dos serviços de saúde. Ferreira P, editor Lisboa.

183. Schwarzer R (2008) Modeling Health Behavior Change : How to Predict and Modify the Adoption and Maintenance of Health Behaviors. Appl Psychol An Int Rev 57: 1–29. doi:10.1111/j.1464-0597.2007.00325.x.

184. Schmidt MF, Mill JS, Fearnside WW, Munson-and R, Schmidt MF (1987) On Classifications of Fallacies. Spring VIII.

185. Magnani L, Belli E (2006) Agent-Based Abduction Being Rational through Fallacies. In: Magnani L, editor. Model-Based Reasoning in Science and Engineering. pp. 1–25.

186. Guha-Sapir D, Schimmer B (2005) Dengue fever: new paradigms for a changing epidemiology. Emerg Themes Epidemiol 2: 1. Available: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=555563&tool=pmcentrez&rendertype=abstract. Accessed 2 April 2014.

187. McKee M, Lang T, Roberts J a (1996) Deregulating health: policy lessons from the BSE affair. J R Soc Med 89: 424–426. Available: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1295881&tool=pmcentrez&rendertype=abstract.

APPENDIX

This section includes these relevant documents mentioned along the manuscript, and are presented in the following order:

- published paper (i):
  Nazareth T, Teodósio R, Porto G, Gonçalves L, Seixas G, Silva AC, Sousa CA (2014) Strengthening the perception-assessment tools for dengue prevention: a cross-sectional survey in a temperate region (Madeira, Portugal). BMC Public Health 14: 39.
- Questionnaire used in study1 (PRE-outbreak cross-sectional survey)
- Questionnaire used in study2 (POST-outbreak cross-sectional survey)
- Guide for Focus group sessions in Study 3
- Focus group sessions citations (Original, in Portuguese) in Study 3

Nazareth et al. BMC Public Health 2014, 14:39
http://www.biomedcentral.com/1471-2458/14/39

BMC Public Health

RESEARCH ARTICLE Open Access

Strengthening the perception-assessment tools for dengue prevention: a cross-sectional survey in a temperate region (Madeira, Portugal)

Teresa Nazareth[1,2,3], Rosa Teodósio[2,4], Graça Porto[1,5], Luzia Gonçalves[6,7], Gonçalo Seixas[3], Ana Clara Silva[8] and Carla Alexandra Sousa[3,9*]

Abstract

Background: Community participation is mandatory in the prevention of Dengue outbreaks. Taking public views into account is crucial to guide more effective planning and quicker community participation in preventing campaigns. This study aims to assess community perceptions of Madeira population in order to explore their involvement in the *A. aegypti*'s control and reinforce health-educational planning. Due to the lack of accurate methodologies for measuring perception, a new tool to assess the community's perceptions was built.

Methods: A cross-sectional survey was performed in the Island's *aegypti*-infested area, exploring residents' perceptions regarding most critical community behaviour: *aegypti*-source reduction and their domestic *aegypti*-breeding sites. A novel tool defining five essential topics which underlie the source reduction's awareness and accession was built, herein called Essential-Perception (EP) analysis.

Results: Of 1276 individuals, 1182 completed the questionnaire (92 · 6%). EP-Score analysis revealed that community's perceptions were scarce, inconsistent and possibly incorrect. Most of the population (99 · 6%) did not completely understood the five essential topics explored. An average of 54 · 2% of residents only partially understood each essential topic, revealing inconsistencies in their understanding. Each resident apparently believed in an average of four false assumptions/myths. Significant association ($p<0.001$) was found between both the EP-Score level and the domestic presence of breeding sites, supporting the validity of this EP-analysis. *Aedes aegypti's* breeding sites, consisting of décor/leisure containers, presented an atypical pattern of infestation comparing with dengue prone regions.

Conclusions: The studied population was not prepared for being fully engaged in dengue prevention. Evidences suggest that EP-methodology was efficient and accurate in assessing the community perception and its compliance to practices. Moreover, it suggested a list of myths that could persist in the community. This is the first study reporting an *aegypti*-entomological pattern and community's perception in a developed dengue-prone region. Tailored messages considering findings of this study are recommended to be used in future campaigns in order to more effectively impact the community perception and behaviour.

Keywords: Dengue prevention, *Aedes aegypti* control, Community involvement, Health education, Community-based participatory research, Community perception, Awareness and perception assessment, Domestic breeding sites, Behavioural change models, Knowledge-attitudes-and-practices surveys

* Correspondence: casousa@ihmt.unl.pt
[3]Unidade de Parasitologia Médica, Instituto de Higiene e Medicina Tropical, Universidade Nova de Lisboa, Lisboa, Portugal
[9]Unidade de Parasitologia e Microbiologia Médica, Instituto de Higiene e Medicina Tropical, Universidade Nova de Lisboa, Lisboa, Portugal
Full list of author information is available at the end of the article

Background

Aedes aegypti is one of the most competent vectors of dengue, yellow fever and chikungunya viruses. Recent estimations suggest a global impact of 390 million dengue infections annually worldwide [1]. Since there are no vaccines or specific treatments for this arboviral infection, the reduction of vector density is one of the most straightforward strategies for its prevention. Furthermore, recent studies unravel the high cost-effectiveness of an active and continuous vector control as opposed to an answer to dengue outbreaks [2]. According to the World Health Organization (WHO), *A. aegypti's* control is mainly achieved by source reduction of the vector through the elimination of the mosquito breeding sites [3]. Due to *A. aegypti's* domestic ecological feature, their larvae preferably proliferate in small and artificial water-containers, placed inside or near human houses [4]. Therefore, community contribution is, undoubtedly crucial in dengue prevention and control [5,6]. Educational campaigns that inform and mobilize the local communities are often implemented in the infested areas. In most preventive campaigns, the community is asked to do *aegypti*-source reduction: to eliminate (cover, empty and/or remove) the most common domestic breeding sites. Abundant literature may be found reporting community-oriented educational interventions and assessments of community knowledge/attitudes/practices/perceptions/beliefs regarding dengue prevention, most of which are performed in tropical regions [7-14]. Even though the relevance of the latter issues is more and more recalled by important entities [15,16], most of the studies emphasize the need of new research approaches to explain and increase their commonly low efficacy [11-14,17,18]. Consequently, studies that suggest and/or test strategies that more effectively promote community behaviours and more accurately assess community perception, are of great need [19]. The 'community perception' term used here means "the collective views of a group of people (…) [perception] involves understanding/misunderstanding and discernment, and it includes a choice and action (…) [perception is also] the product of social interaction", as stated by WHO [19].

In the past years, several viruses and vectors have significantly increased their geographic distribution as a result of globalization [20,21]. In 2005, *A. aegypti* specimens were recorded for the first time in Madeira, a temperate European island in the Atlantic [22]. Rapidly, the local health authorities promoted educational activities based on television/radio communications, informative flyers/posters distribution and 'door-to-door' interventions to achieve community compliance in the domestic control of *A. aegypti* [23]. In fact, despite these efforts, the mosquito population has thrived. Additionally, entomological studies reported high levels of resistance to DDT and pyrethroids in the local *A. aegypti* population [24].

In October 2012, less than one year after the beginning of this study, an outbreak of dengue was declared in the Island [25]. Currently, Madeira is at risk of becoming a dengue endemic territory. Also, being a highly touristic destination, it constitutes an open door for *A. aegypti* and/or dengue virus introduction into other temperate regions [26]. Moreover, non-tropical regions such as Europe and North America host *Aedes albopictus* another very competent arboviral vector [27-29]. A unique virus introduction into these temperate regions could trigger a disease epidemic [30]. Community-mobilization strategies that effectively reduce *A. aegypti's* densities in Madeira Island are thus, mandatory.

This study aims to estimate the community's perceptions of Madeira residents regarding source reduction, and identify the most frequent *aegypti*-breeding sites present in the domestic environment of this non-tropical region. An extensive and in-depth analysis is suggested as a novel tool for community perception assessment and educational planning.

Methods

Studied population

The study area was chosen according to the *A. aegypti's* distribution area, assessed by an island-wide entomological survey (Additional file 1). Based on mosquito abundance levels, a more restrictive zone called 'AEGYPTI', was selected. This area includes part of three municipalities: Santa Luzia and São Pedro (both in Funchal county), and Câmara de Lobos (in a Funchal neighbouring county). A representative sample of residents aged 18 years old or over was selected from the electoral system database, using stratified sampling by the municipality. A universe of 13 433 adult subjects lived in the area of study (almost 7% of the Island's adult total population) [31]. A sample size of 1083 subjects, was required to fulfil the objectives of this study (90% confidence level and 2·5% precision). A prevalence of 50%, regarding good knowledge, was assumed. This sample size was inflated in 20% to account for non-respondents and incomplete interviews. Individuals who were not found or who refused to participate were replaced.

Questionnaire and entomological inventory

A cross-sectional survey was performed through face-to-face interviews. In each interview, both a questionnaire to assess the residents' perceptions and a domestic breeding site inventory of each household, were fulfilled. The surveys were performed by trained personnel (Health technicians of the local authority-IASAUDE) during October and November 2011. A total of three attempts were undertaken to contact the selected individuals: (i)-on weekdays between 9 am and 5 pm; (ii)-on weekdays between 5 pm and 8 pm; and (iii)-on Saturdays between 10 am and 7 pm. Participants gave oral informed consent prior to data collection.

Previous to its application, the questionnaire was pre-tested in an *aegypti*-infested but non-selected area. The questionnaire comprised 13 questions, addressing five main topics (see criteria in Perceptions Evaluation paragraph): 'Medical Importance' (two questions), 'Local Risk' (two questions), 'Domestic Attribute' (three questions), 'Mosquito Breeding' (three questions) and 'Control Measures' (three questions). The questionnaire also covered socio-demographic characteristics. The breeding site inventory listed 21 types of putative domestic breeding sites present in each household. The study was approved by *Instituto de Higiene e Medicina Tropical Ethics Committee* (reference: 09-2013-TD).

EP-analysis (Perception evaluation)

The most common answer frequency estimation was calculated (data not shown).

However, in order to accomplish accurate and in-depth perception estimation, several analysis were performed.

A list of five essential topics regarding source reduction was defined. Topics correspond to variables known to determine behaviour changes, such as, self-efficacy, behavioural expectancies, perceived susceptibility, etc. as mentioned in several models of behavioural change described in the literature [18,32]. According to behavioural change experts, the list of variables/topics were chosen and adapted to dengue context and to the particular Madeira scenario [18,32]. The five selected variables (here called 'topics') are individually labelled as: (*A. aegypti*'s) Medical Importance, (its) Local Context, Domestic Attribute (of its vector-control), Mosquito Breeding (process) and finally, (vector)-Control Measures. We established the awareness and the understanding of these five topics as necessary and obligatory for the acceptance of (and presumed consequent adherence to) source reduction practice.

Two concepts were selected to evaluate each of the latter five topics (these are here called 'Essential concepts'). By evaluating the acknowledgement of both Essential concepts, a double-evaluation of the understanding of each of the five topics was done. This allowed for the detection of discrepancies in the way these five topics are understood. Collectively the ten concepts sum-up the awareness of the source reduction. This way, this methodology allows the estimation of the community's perceptions through four distinct approaches: (i)-score of Essential-Perception, (ii) concept's assimilation, (iii) topic understanding and (iv)-discrepancy detection/myth estimation, all described below.

Concepts assimilation and score of essential-perceptions (EP-score)

According to the residents' answers, the acknowledgement of the ten essential concepts was calculated. Each concept corresponds to one or two questions. We obtained the EP-score for each resident assimilated (from 0 to 10), by attributing one point to each perceived essential concept. Thus, EP-score level corresponds to the number of (essential) concepts, out of the ten established that each resident has assimilated. Following EP-analysis' criteria, only those who achieved an EP-score equal to 10 showed minimal and adequate perceptions to trigger individual compliance in source reduction (see an example in Additional file 2). Respondents who have not answered all the 13 questions were excluded from score calculation.

Topic understanding

The understanding of the five covered topics was evaluated according to the knowledge shown in topic-related essential concepts (Graphic 1 and 2). Only residents who had acknowledged both topic-related concepts had completely understood the topic. The acknowledgement of only one out of the two topic-related concepts revealed a partial understanding. Residents who did not perceive any of the two topic-related concepts did not understand the topic.

Discrepancy detection/myths estimation

Partial or absent understanding of one of the five topics could generate false perceptions concerning it (Additional file 3). By analyzing the acknowledgement of both Essential concepts for each topic and the discrepancies in its understanding, a list of myths (false information that is perceived as true by a part of the population) was estimated and also its supposed frequency in the population (Additional file 4).

Statistical analysis

All collected information was introduced and records were double-checked. Statistical analysis was performed using Excel (Microsoft Office, Windows Vista) and Statistical Package for Social Sciences 19.0 (SPSS, Inc., Chicago, IL, USA). Answers obtained from the questionnaire were recoded to obtain other categorical variables linked to the above mentioned ten concepts. Determinants of the EP-Score level and predictors of the domestic presence of breeding-sites were also explored. EP-Score percentiles for each socio-demographic group were calculated following Weighted Average method. Comparisons of score medians between socio-demographic groups were made using non parametric tests: Mann–Whitney and Kruskal-Wallis. Associations/differences with the domestic presence of breeding sites were performed using three different approaches: (i)-individual essential concepts: assessed by a chi-square test for categorical variables; (ii)-EP-Score: assessed by Weighted Averaged method and Mann–Whitney test; (iii)-Incomplete Scores (four combinations of scores covering four out of the five main topics) also assessed by Weighted Averaged method and Mann–Whitney test. In this latter point (iii), by filtering the residents that showed zero points regarding each of the five topics separately,

four combinations of incomplete EP-Scores (from 0 to 8 points) were generated. Additionally, logistic regression models were also performed to explore socio-demographic factors that contribute to achieve, or not, an EP-Score equal to or higher than seven. The cut-off would preferably be an EP-Score equal to 10 (instead of 7). However, due to the inexistence of a minimum number of individuals that have reached the maximum (EP = 10), the cut-off was adjusted until 7 in order to include a enough number of individuals needed to perform the logistic regression.

Results

A total of 1276 AEGYPTI-residents participated in the study. Out of these, only 92 · 6% (1182 individuals) answered the 13 questions and were scored according to the perceptions demonstrated. All individuals' residences were inventoried to putative breeding sites. Table 1 shows the socio-demographic characteristics of the studied population.

EP-analysis

EP-score and concepts assimilation

Respondents' EP-score distribution is represented in Figure 1. Only 0 · 4% out of the scored respondents (5 individuals) achieved an EP-score = 10. The total population recognized an average of five essential concepts, half of those evaluated.

Population acknowledged the ten essential concepts differently (Figure 2). The concepts 'Medical Importance 1' and 'Control Measures 1' were the most well-acknowledged; 86 · 3% of the interviewed admitted that mosquitoes can transmit diseases (MI1-concept) and 77 · 2% referred to the reduction of breeding sites as being a "(fairly/very/extremely) effective measure" in controlling mosquitoes (CM1-concept). On the contrary, concepts 'Control Measures 2' and 'Domestic Attribute 1' were the least recognized; only 26 · 4% acknowledged that "mosquitoes can breed inside houses" (DA1-concept) whereas only 20 · 3% of the studied population correctly admitted to CM2-concept which did not identifying the use of a flyswatter or indoor insecticide spraying, as effective for *aegypti*-control.

Topic understanding

Regarding the topics, shown in Figure 3, 'Medical importance' was the one that more people have completely understood (31 · 9% of the studied population), while both the concepts related to 'Control Measures' were only recognized by 13 · 0% of the respondents. By analysing each topic separately, Graphic 3 reveals that the majority of the respondents presented partial understanding of four out of the five topics. Differently, for 'Local Risk' the highest proportion of the respondents disregarded both topic-related concepts.

False perceptions/myths estimation

Based on the analysis of AEGYPTI-residents topics understanding a list of 13 alleged myths was elaborated and its supposed frequency in the population calculated (Table 2). The most disseminated myth was: "the insecticide usage as an effective measure to control *aegypti*-mosquitoes" found in 79 · 7% of the scored population. Each resident believed, on average, in 4 out of the 13 myths. Most of them (99 · 5%) believed at least in one myth (Table 2).

Entomological description, its determinants and correlations with perceptions

Out of all the 1276 interviewed individuals 79 · 6% lived in houses with at least one putative breeding site. The most frequent breeding sites were: flower-pot dishes, present in 52 · 7% of the respondent's houses; out-door sinks (35 · 7%); water-accumulation on decks (23 · 3%); flower vases (21 · 7%) and pet water-dishes (18 · 8%) (Additional file 5).

Statistical tests were performed in order to explore whether or not the presence of breeding sites were determined by the EP-Score level. According to Table 3, no significant differences were found between those that admitted/not admitted to concepts 'Mosquito Breeding1' and 'Control Measures 1'. However, residents who had breeding sites in their households had significantly lower EP-scores compared to those living in houses without breeding sites (Table 3). Comparing the five 'Incomplete Scores' within both of the residents' houses with/without domestic breeding sites, none of the five combinations varied significantly (see Table 4). Municipality also presented significant association with the presence of domestic breeding sites, being 'Santa Luzia' the one with higher frequency of households without breeding sites (Additional file 6).

Socio-demographic characteristics and perception determinants

All analysed socio-demographic characteristics presented significant differences in EP-scores medians (Table 1). Actually, all males, residents aged 26–35 years old, people that had 12 years or more of education, individuals that live in 'Santa Luzia', respondents that have travelled to EC and those that admitted to have been bitten by mosquitoes, have embraced more essential concepts than their correspondent socio-demographic groups. Following the logistic regression, four socio-demographic characteristics significantly determined a minimum of seven acknowledged essential concepts (EP-Score equal to or higher than seven). These were residents' 'gender', 'municipality', the eventuality of being 'bitten by mosquitoes' and above all 'educational level' (Additional file 7).

Discussion

Comparing to other studies, analysis of single concept frequency revealed an (apparent) very good community

Table 1 Socio-demographic characterization of the inquired / scored population and EP-Score results per socio-demographic groups

	Inquired population (n = 1276)	Scored population (n = 1182)		
	n	n (%)	EP-score median (P_{25}-P_{75})$^{+}$	*p*-value
Gender (n = 1267)				<0·001‘
Male	506	480 (40·6)	5·0 (4·0 - 7·0)	
Female	761	701 (59·4)	5·0 (3·0 - 6·0)	
Education level (years) (n = 1251)				<0·001“
Never studied (0)	75	69 (5·9)	3·0 (2·0 – 4·0)	
Fourth grade (4)	484	446 (38·2)	4·0 (3·0 – 5·0)	
Ninth grade (9)	281	262 (22·5)	5·0 (4·0 – 6·0)	
High school (12)	220	207 (17·7)	6·0 (4·0 – 7·0)	
Upper education (+12)	191	183 (15·7)	7·0 (6·0 – 8·0)	
Age groups (years) (n = 1256)				<0·001“
25 or younger	170	154 (13·2)	4·0 (3·0 – 6·0)	
26-35	172	161 (13·8)	5·0 (3·0 – 7·0)	
36-45	197	191 (16·3)	5·0 (4·0 – 7·0)	
46-55	221	207 (17·7)	5·0 (4·0 – 7·0)	
56-65	182	174 (14·9)	5·0 (3·0 – 6·0)	
66-75	185	167 (14·3)	5·0 (3·0 – 6·0)	
76 or older	129	116 (9·9)	4·0 (3·0 – 6·0)	
Municipality (n = 1275)				<0·001“
Santa Luzia	417	388 (32·9)	6·0 (4·0 – 7·0)	
São Pedro	314	304 (25·7)	5·0 (4·0 –7·0)	
Câmara de Lobos	544	489 (41·4)	4·0 (3·0 – 5·0)	
Travelled to EC* (n = 1245)				<0·001‘
Yes	311	287 (24·7)	5·0 (4·0 – 7·0)	
No	934	876 (75·3)	5·0 (3·0 – 6·0)	
‘Bitten by mosquitoes’ (n = 1271)				
Yes	944	887 (75·2)	5·0 (4·0 – 7·0)	<0·001‘
No	327	293 (24·8)	4·0 (3·0 – 6·0)	

Some descriptive statistics (percentages, median, and percentiles) illustrate the socio-demographic feature and EP-score results. Comparisons of EP-score's medians between socio-demographic groups are also presented (*p*-values). Not all the respondents answered to all the socio-demographic questions, thus correspondent n values are described.
$^{+}$Weighted Average method; ‘Mann–Whitney test; “Kruskal-Wallis test.

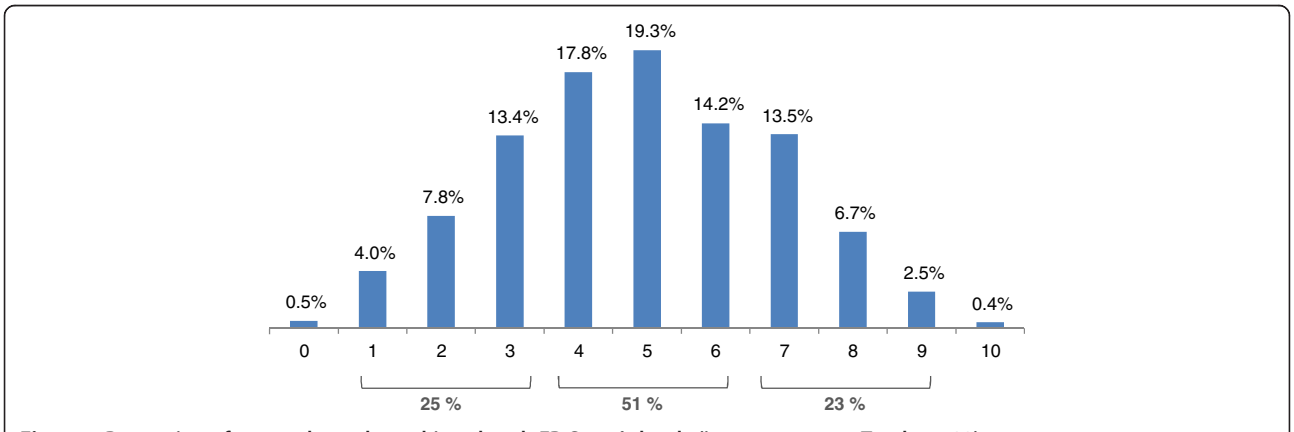


Figure 1 Proportion of respondents that achieved each EP-Score's levels (in percentage, n Total = 1182).

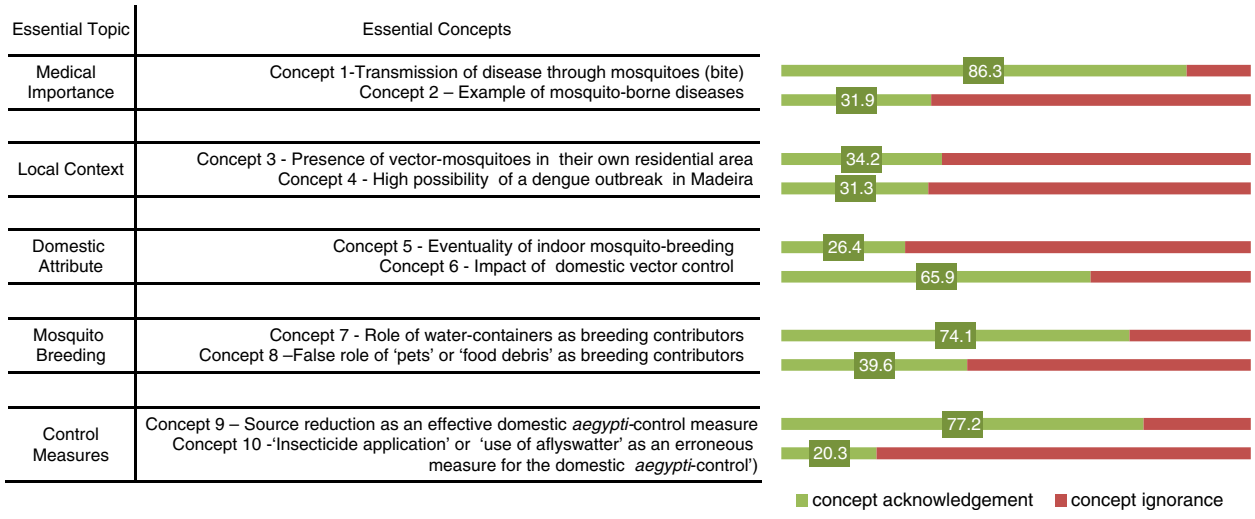


Figure 2 Proportion of respondents that acknowledged each Essential Concept.

knowledge [12,13]. For example, almost 80% of the population recognized that "the source reduction is an effective measure for domestic *aegypti*-control" (Control Measure 1). However, perception evaluation based on EP-score showed that several essential concepts are still unknown by the majority of the population. Regarding topics understanding, only a few respondents completely understood each of the five topics. In all of them, a great discrepancy was found within the knowledge shown in concepts covering the same topic, predicting the presence of alleged myths/erroneous perceptions in most of the AEGYPTI-population. As suggested in Additional file 3, the dissemination of part of the information can promote the advent of myths. To notice, through an anthropological view these myths are considered the real perception of the community [33]. They are here called 'erroneous perceptions or myths' since they oppose and contradict what, to date, is considered to be the main community vector-control practice. Sequential educational activities should take into account those myths given that they could be much harder to amend than the lack of awareness itself.

Four socio-demographic determinants were described in the logistic regression results. Similarly to other studies, the education level was the most relevant determinant in the EP-Score level above 7, emphasizing the relevance of

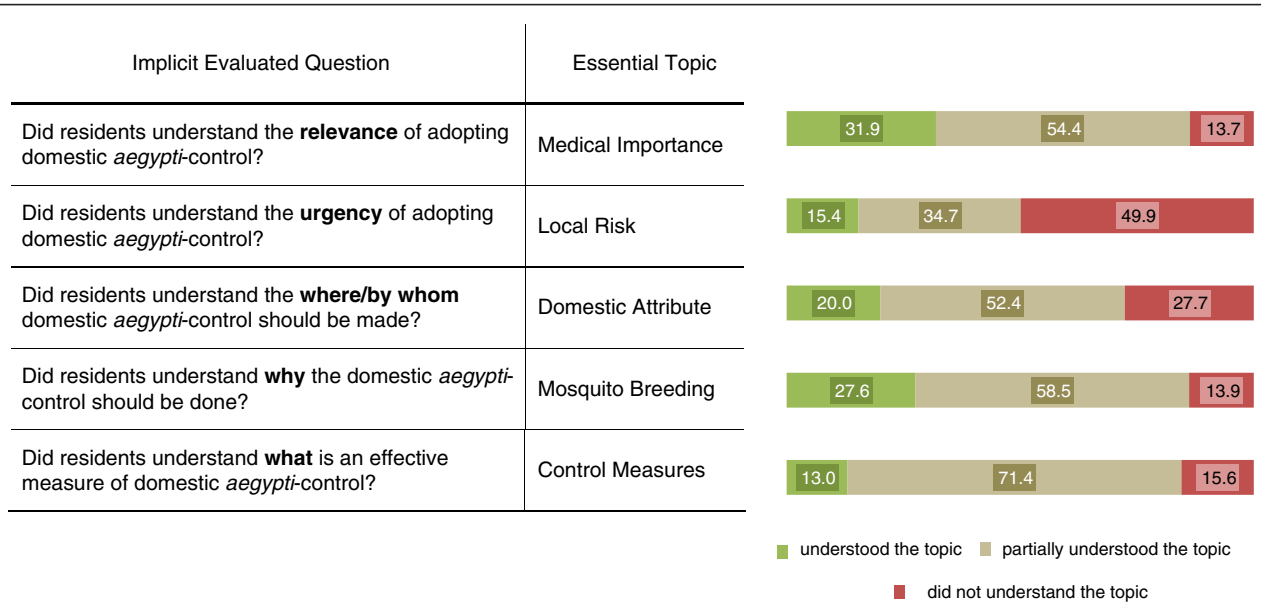


Figure 3 Proportion of respondents that 'understood', 'partially understood' and 'did not understand' each Essential Topic.

Table 2 List of the thirteen alleged myths and proportion of residents that believed in each of them

Essential topic		Alleged myth	n (%)
Medical importance	Myth 1	"Mosquitoes only cause mild clinical consequences such as allergies, fever, etc".	643 (54 · 4)
	Myth 2	"Mosquitoes do not transmit diseases".	162 (13 · 7)
Local risk	Myth 3 and Myth 4	"Dengue is not a mosquito-borne disease" and/or "Dengue only occur in tropical/non-developed countries".	222 (18 · 8)
	Myth 5 and Myth 6	"Since I do not feel the byte, I am not at risk of being bitten/infected" and/or "Mosquitoes are allocated in a specific area and are not able to spread through the island".	188 (15 · 9)
	Myth 7	"Madeira's residents are not at risk".	590 (49 · 9)
Domestic attribute	Myth 8	"Local health authorities are the key intervenient in the control of mosquitoes".	76 (6 · 4)
	Myth 9	"Insecticides or other protective measures can control mosquitoes".	543 (45 · 9)
	Myth 10	"I am (Community is) not an intervenient in the *aegypti*-control".	590 (49 · 9)
Mosquito breeding	Myth 11 and Myth 12	"Clean houses or houses without pets/animals do not have mosquitoes" and/or "Clean people have nothing to do concerning the control of mosquitoes".	714 (60 · 4)
Control measures	Myth 13	"By the usage of insecticides and/or flyswatter, I am already contributing to the *aegypti*-control".	942 (79 · 7)

Based on the analysis of the discrepant knowledge showed concerning topic-related concepts, false assumptions/myths were inferred to be present in the scored population (see Myths' estimation and Myth's appearance on Additional files).
Average of believed myths per scored resident: four out of the thirteen myths.
Proportion of scored residents that believed in at least one alleged myth: 99 · 5%.

extensive health education programs to improve the health-literacy levels [34-37]. The 'bitten by mosquitoes' variable (stating the recognition of having been bitten by mosquitoes) also showed to be a determinant in the level of EP-Score. These suggests that measures that make the problem more 'visible' would be of a great impact in community awareness, especially for those who lack the allergic reaction to the bite. Determinants such as, 'Gender', and 'Municipality' should be considered in the selection of target groups/areas for further campaigns.

Concerning the entomological survey, only putative breeding sites were inventoried. Due to the un-expected absence of rainfall during the period of the study (carried-out during the beginning of the rainy season), most of the containers were dry (Additional file 8). Nevertheless, this was, to our knowledge, the sole entomological survey in a temperate region describing the most common *A. aegypti*'s domestic breeding sites. The most inventoried putative breeding sites were housing-components present in any patio, balcony or garden areas. An *aegypti*-infestation pattern was observed compatible with a clean, organized and well maintained urban environment (as schematized in Additional file 9). These results contrast with the common symbols of mosquito infestation in dengue endemic regions, often related to water supply and waste disposal (tires, water tanks, etc.) [38-40]. 'Santa Luzia"s municipality showed a significantly higher percentage of houses without breeding sites compared to the other two municipalities. This could be explained by a higher conscience of the *A. aegypti*'s presence in 'Santa Luzia' since it was where this mosquito first appeared.

Associations found between EP-Score and presence of domestic breeding sites supported the established criteria (Tables 3 and 4). The important and most acknowledged concepts: DA2 and CM1, *per se* did not correlate with the absence of breeding sites. Yet, the EP-score level is significantly higher in respondents living in households without putative breeding sites (Table 1). These results seem to support that essential-concepts' cumulative assimilation is needed for triggering the adoption of the aimed

Table 3 Associations between the domestic presence of putative breeding sites (any type) and: (a) acknowledgement of concept 'Mosquito Breeding1'; (b) acknowledgement of concept 'Control Measure 1' and (c) cumulative essential-concepts' acknowledgement: EP-score

		Residents living in houses…				
		…WITH breeding-sites		….WITHOUT breeding-sites		
		n (%)	median (P_{25}-P_{75})$^{+}$	n (%)	median (P_{25}-P_{75})$^{+}$	*p*-value
(a) "Role of water-containers as breeding contributors (Concept 7)"	Acknowledged	699 (73 · 4)	-	177 (77 · 0)	-	0 · 272$^{\vee}$
	Did not acknowledge	253 (26 · 6)	-	53 (23 · 0)	-	
(b) "Source reduction as an effective domestic *aegypti*-control measure (Concept 9)"	Acknowledged	728 (76 · 5)	-	184 (80 · 0)	-	0 · 253$^{\vee}$
	Did not acknowledge	224 (23 · 5)	-	46 (20 · 0)	-	
(c) EP-score		952 (80 · 5)	5 · 0 (3 · 0 – 6 · 0)	230 (19 · 5)	5 · 0 (4 · 0 – 7 · 0)	0 · 001$^{\prime}$

$^{\prime}$Mann–Whitney test; $^{\vee}$Pearson test; $^{+}$Weighted Average method.

Table 4 Association of EP-Incomplete Scores and presence of domestic breeding sites

Essential topic excluded	Residents living in houses WITH breeding-sites n; median (P_{25}-P_{75})$^{+}$	Residents living in houses WITHOUT breeding-sites n; median (P_{25}-P_{75})$^{+}$	*p* - value$^{'}$
Medical importance	137 ; 2·0 (2·0 – 4·0)	25 ; 3·0 (1·0 – 4·0)	0.615
Local risk	484 ; 4·0 (3·0 – 5·0)	106 ; 4·0 (3·0 – 5·0)	0.399
Domestic attribute	267 ; 3·0 (2·0 – 4·0)	60 ; 3·0 (2·0 – 4·0)	0.515
Mosquito breeding	138 ; 3·0 (2·0 – 4·0)	26 ; 3·0 (1·0 – 3·0)	0.367
Control measures	155 ; 3·0 (2·0 – 3·0)	29 ; 2·0 (1·0 – 3·0)	0.351

Incomplete EP-score covered only four out of the five Essential Topics.
'Mann–Whitney test; $^{+}$Weighted Average method.

behaviour. Moreover, results from the Incomplete Scores revealed that none of the five topics were dispensable in the improvement of the source reduction compliance. Evidence was provided to use the EP-Score analysis as an accurate tool for perception estimation. Furthermore, comparing to the alternative simple analysis of frequencies (see Table 3), this tool provides deeper and more precise results to explore the community involvement. Actually, the major limitation of knowledge/perception assessments is the lack of its correlation with the adoption of proposed practices, frequently observed in similar studies (most commonly, knowledge-attitudes-and-practices surveys) [10,14,15,34-36,41]. Methodologies that estimate awareness based on a score were already used in other surveys [13,14]. However, these approaches rarely or never focus on a specific behaviour, and almost never test understanding discrepancies. Since the adoption of different dengue-related practices (preventing, protecting, diagnosing, treatment-seeking practices, etc.) implicates the understanding of distinct concepts, behaviour-oriented approaches are much more useful to prioritize health-messages and plan campaigns [41]. Analysis of discrepancies in the understanding has been suggested as a way to improve reliability in KAP surveys [17]. Similar studies are now needed to confirm whether this approach is indeed more accurate to assess perceptions and more effective to promote behaviours in the community.

Conclusions

After seven years of coexistence with the *A. aegypti,* Madeira Island presents an atypical scenario of domestic infestation. Subsequent to several local educational activities, AEGYPTI-community perceptions regarding source reduction were not only insufficient, but also, inconsistent and possibly incorrect. Findings of this study provide crucial guidelines for future educational activities. By addressing the less acknowledged essential concepts and the alleged myths, and by emphasizing the most frequent breeding sites, health messages adapt their content and their focus to more likely help the community in fully engaging in the proposed behaviour. However, after the experience of a dengue outbreak (2012), local population has probably altered their perception, namely in what concerns the topic 'Local Risk'. Moreover, since, no hemorrhagic clinical cases were detected in the latter outbreak, the real 'Medical Importance' of dengue could be still underestimated. These ideas should also be considered by those planning further educational activities on the island. As part of future actions the implementation of another questionnaire, similar to the one carried-out in this study, should be encouraged. In reality, with its recent dengue event, Madeira Island presents an exceptional opportunity to understand the effect of a disease-outbreak in a community's awareness. Finally, findings of this study support the use of EP-Score methodology as a more efficient tool to evaluate the community-perception regarding a specific behaviour. When further tested, this type of tool will probably prove to be of great value for other health problems, far beyond dengue prevention.

Additional files

Additional file 1: *A. aegypti*'s distribution area (2001). Ovitrap distributions in the two inhabited island of Madeira's archipelago: Madeira and Porto Santo (2011). Red Points correspond to positive ovitraps, Green Points correspond to negatives ones.

Additional file 2: Relevance of cumulative knowledge. Exploring why a 'higher' level of knowledge doesn't necessarily reflect a 'better' awareness.

Additional file 3: Myth's appearance. Explaining an example of how a myth can appear from a partial (non-cumulative) understanding.

Additional file 4: False perceptions/myths estimation through the analysis of residents' topic understanding.

Additional file 5: Domestic breeding sites. Percentage (%) of inquired residents living in houses with each type of breeding site (n Total =1276).

Additional file 6: Domestic breeding sites predictors. Associations/differences with socio-demographic data.

Additional file 7: Multiple regression model predicting socio-demographic determinants to achieve at least seven perceived essential concepts (EP-score equal to or higher than seven).

Additional file 8: Variation of the temperature, humidity and precipitation from September 2011 to July 2012 in Madeira Island.

Additional file 9: Representation of the *aegypti*-infestation pattern found in the domestic regions of AEGYPTI-area in Madeira Island.

Abbreviations
WHO: World Health Organization; EP-score: Score of essential-perception; AEGYPTI: Madeira's geographical area of major *A. aegypti*'s abundance levels at 2011 and selected for the present survey; KAP: Knowledge attitudes and practices.

Competing interests
The authors declare that they have no competing interests.

Authors' contributions
TN and GS collectively worked in data collection and made literature search. Study-design was elaborated by TN, CAS, RT, GP and ACS. Statistical analysis was performed by TN and LG. Latter authors together with CAS, RT and GP worked on data interpretation and writing. All authors read and approved the final manuscript.

Acknowledgements
We thank to Fundação para a Ciência e Tecnologia (FCT) for funding this work (references: PTDC/SAU-EPI/115853/2009 and SFRH/BD/51012/2010, all the survey respondents who participated in the study, and the survey staff who did the interviews.

Author details
[1]GABBA Doctoral Program, ICBAS, Abel Salazar Institute for the Biomedical Sciences, University of Porto, Porto, Portugal. [2]Unidade Clínica Tropical, Instituto de Higiene e Medicina Tropical, Universidade Nova de Lisboa, Lisboa, Portugal. [3]Unidade de Parasitologia Médica, Instituto de Higiene e Medicina Tropical, Universidade Nova de Lisboa, Lisboa, Portugal. [4]Centro de Malária e Doenças Tropicais, Instituto de Higiene e Medicina Tropical, Universidade Nova de Lisboa, Lisboa, Portugal. [5]IBMC, Institute for Molecular and Cellular Biology, Porto, Portugal. [6]Unidade de Saúde Pública e Internacional e Bioestatística, Instituto de Higiene e Medicina Tropical, Universidade Nova de Lisboa, Lisboa, Portugal. [7]Centro de Estatística e Aplicações da Universidade de Lisboa (CEAUL), Universidade de Lisboa, Lisboa, Portugal. [8]Departamento de Saúde, Planeamento e Administração Geral, Instituto de Administração da Saúde e Assuntos Sociais, IP-RAM, Funchal, Portugal. [9]Unidade de Parasitologia e Microbiologia Médica, Instituto de Higiene e Medicina Tropical, Universidade Nova de Lisboa, Lisboa, Portugal.

Received: 19 July 2013 Accepted: 17 December 2013
Published: 15 January 2014

References
1. Murray EAN, Quam MB, Wilder-Smith A: **Epidemiology of dengue: past, present and future prospects.** *Clin Epidemiol* 2013, **5:**299–309.
2. Stahl H-C, Butenschön VM, Tran HT, Gozzer E, Skewes R, Mahendradhata Y, Runge-Ranzinger S, Kroeger A, Farlow A: **Cost of dengue outbreaks: literature review and country case studies.** *BMC Public Health* 2013, **13:**1048.
3. WHO: *Working to overcome the global impact of neglected tropical diseases*; 2010:6.
4. Jansen CC, Beebe NW: **The dengue vector Aedes aegypti: what comes next.** *Microbes Infect* 2010, **12:**272–9.
5. Gubler DJ, Clark GG: **Community-based integrated control of aedes aegypti: a brief overview of current programs.** *Am J Trop Med Hyg* 1994, **50:**50–60.
6. Winch P, Kendall C, Gubler D: **Effectiveness of community participation in vector-borne disease control.** *Health Policy Plan* 1992, **7:**342–51.
7. Vanlerberghe V, Toledo ME, Rodriguez M, Gomez D, Baly A, Benitez JR, Van der Stuyft P: **Community involvement in dengue vector control: cluster randomised trial.** *BMJ* 2009, **338:**b1959–b1959.
8. Al-Muhandis N, Hunter PR: **The value of educational messages embedded in a community-based approach to combat dengue Fever: a systematic review and meta regression analysis.** *PLoS Negl Trop Dis* 2011, **5:**e1278.
9. dos Santos SL, Cabral ACAL: **Knowledge, attitude and practice on dengue, the vector and control in an urban community of the Northeast Region, Brazil.** *Ciências e Saúde Coletiva* 2011, **16:**1319–1330.
10. Espinoza-Gómez F, Hernández-Suárez CMCR: **Educational campaign versus malathion spraying forthe control of Aedes aegypti in Colima, México.** *J Epidemiol Community Health* 2002, **56:**148–152.
11. Itrat A, Khan A, Javaid S, Kamal M, Khan H, Javed S, Kalia S, Khan AH, Sethi MI, Jehan I: **Knowledge, awareness and practices regarding dengue fever among the adult population of dengue hit cosmopolitan.** *PloS one* 2008, **3:**e2620.
12. Koenraadt CJM, Tuiten W, Sithiprasasna R, Kijchalao U, Jones JW, Scott TW: **Dengue knowledge and practices and their impact on Aedes aegypti populations in Kamphaeng Phet, Thailand.** *Am J Trop Med Hyg* 2006, **74:**692–700.
13. Winch PJ, Leontsini E, Rigau-Pérez JG, Ruiz-Pérez M, Clark GG, Gubler DJ: **Community-based dengue prevention programs in Puerto Rico: impact on knowledge, behavior, and residential mosquito infestation.** *Am J Trop Med Hyg* 2002, **67:**363–70.
14. Chinnakali P, Gurnani N, Upadhyay RP, Parmar K, Suri TM, Yadav K: **High level of awareness but poor practices regarding dengue fever control: a cross-sectional study from north India.** *Am J Med Sci* 2012, **4:**278–82.
15. Reidpath DD, Allotey P, Pokhrel S: **Social sciences research in neglected tropical diseases 2: A bibliographic analysis.** *Health research policy and systems / BioMed Central* 2011, **9:**1.
16. WHO and the Health and Environment Linkages Initiative: *Better Environmental Management for Control of Dengue*; 2013:1–4.
17. Launiala A: **How much can a KAP survey tell us about people's knowledge, attitudes and practices?** *Anthropol Matters* 2009, **11**(1):1–13.
18. Hausmann-muela S, Ribera JM, Nyamongo I: **Health-seeking behaviour and the health system response DCPP working paper.** 2003, **14:**3–23.
19. Dowler E, Green J, Bauer M: **Assessing public perception: Issues and methods.** In *Health, hazards and public debate: Lessons for risk communication from the BSE/CJD saga.* Edited by Dora C. Geneva: WHO; 2006:39–60.
20. Reiter P: **Climate change and mosquito-borne disease.** *Environ Health Perspect* 2011, **109:**21.
21. Gubler DJ: **Dengue and dengue hemorrhagic fever.** *Clin Microbiol Rev* 1998, **11:**480–96.
22. Almeida AP, Gonçalves YM, Novo MT, Sousa CA, Melim MGA: **Vector monitoring of aedes aegypti in the autonomous region of Madeira, Portugal.** *Euro Surveill* 2007.
23. Setbon M, Raude J: **Population response to the risk of vector-borne diseases: lessons learned from socio-behavioural research during large-scale outbreaks.** *Emerg Health Threats J* 2009, **2:**e6.
24. Seixas G: *Aedes (Stegomyia) aegypti (Diptera, Culicidae) from Madeira Island: geographical origin and insecticide resistance. Master thesis.* Lisbon: Instituto de Higiene e Medicina Tropical, Universidade Nova de Lisboa; 2012.
25. Sousa CA, Clairouin M, Seixas G, Viveiros B, Novo MT, Silva AC, Escoval MT, Economopoulou A: **Ongoing outbreak of dengue type 1 in the Autonomous Region of Madeira, Portugal: preliminary report.** *Euro Surveill* 2012, **17:**8–11.
26. ECDC: *Communicable Disease Threats Report*; 2013. http://www.ecdc.europa.eu/en/publications/Publications/communicable-disease-threats-report-9-feb-2013.pdf.
27. Rezza G: **Aedes albopictus and the reemergence of Dengue.** *BMC Public Health* 2012, **12:**72.
28. Gould EA, Gallian P, De Lamballerie X, Charrel RN: **First cases of autochthonous dengue fever and chikungunya fever in France: from bad dream to reality!** *Clin Microbiol Infect* 2010, **16:**1702–1704.
29. Wright WF, Pritt BS: **Update: The diagnosis and management of dengue virus infection in North America.** *Diagn Microbiol Infect Dis* 2012, **73:**215–20.
30. ECDC: *Rapid Communications*; 2013.
31. Instituto Nacional de Estatística: *Censos 2001 Resultados Definitivos.* Região Autónoma da Madeira: XIV recenseamento geral da população. IV recenseamento geral da habitação; 2002. ISBN ISBN 972-673-609-9.
32. Armitage CJ, Cower M: **Social cognition models and health behaviour: a structured review.** *Psychol Health* 2000, **15:**173–189.
33. Pelto PJ, Pelto G: **Studying knowledge, culture, and behavior in applied medical anthropology.** *Med Anthropol Q* 1997, **11**(2):147–163.
34. Kirkby K, Galappaththy GNL, Kurinczuk JJ, Rajapakse S, Fernando SD: **Knowledge, attitudes and practices relevant to malaria elimination amongst resettled populations in a post-conflict district of northern Sri Lanka.** *Trans R Soc Trop Med Hyg* 2012. doi:10.1093/trstmh/trs015.
35. Raude J, Chinfatt K, Huang P, Betansedi CO, Katumba K, Vernazza N, Bley D: **Public perceptions and behaviours related to the risk of infection with Aedes mosquito-borne diseases: a cross-sectional study in Southeastern France.** *BMJ open* 2012, **2**.
36. Dégallier N, Vilarinhos PT, de Carvalho MS, Knox M, Caetano J Jr: **People's knowledge and practice about dengue, its vectors and control means in**

Brasilia (DF), Brazil: its relevance with entomological factors. *J AM Mosq Control Assoc.* 2000, **16**(2):114–23.
37. Rosenbaum J, Nathan MB, Ragoonanansingh R, Rawlins S, Gayle C, Chadee DD, Lloyd LS: **Community participation in dengue prevention and control: a survey of knowledge, attitudes, and practice in Trinidad and Tobago.** *Am J Trop Med Hyg* 1995, **53:**111–7.
38. Medronho RA, Macrini L, Novellino DM, Lagrotta MTF, Câmara VM, Pedreira CE: **Aedes aegypti immature forms distribution according to type of breeding site.** *Am J Trop Med Hyg* 2009, **80:**401–404.
39. Burkot TR, Handzel T, Schmaedick MA, Tufa J, Roberts JM, Graves PM: **Productivity of natural and artificial containers for Aedes polynesiensis and Aedes aegypti in four American Samoan villages.** *Med Vet Entomol* 2007, **21:**22–29.
40. Bagny L, Delatte H, Elissa N, Quilici S, Fontenille D: **Aedes (diptera: culicidae) vectors of arboviruses in Mayotte (Indian ocean): distribution area and larval habitats.** *J Med Entomol* 2009, **46**(2):198–207.
41. (WHO) PW and LL: *Planning Social Mobilization and Communication for Dengue Fever Prevention and Control*; 2004:35–36.

doi:10.1186/1471-2458-14-39
Cite this article as: Nazareth *et al.*: Strengthening the perception-assessment tools for dengue prevention: a cross-sectional survey in a temperate region (Madeira, Portugal). *BMC Public Health* 2014 **14**:39.

IASAÚDE, IP-RAM

Inquérito sobre mosquitos aos residentes na ilha da Madeira

Nome do entrevistador:_____

Data:_____ Inquérito nº : _____

1. **Na zona onde mora, os mosquitos causam-lhe incómodo (são desagradáveis, picam)?**

○ NÃO

○ SIM ⟶ SE SIM, **Em que medida os mosquitos o incomodam?**

MUITO POUCO - POUCO - MÉDIO - MUITO - MUITÍSSIMO

2. **Na zona onde mora, os mosquitos, são para si, um motivo de preocupação, ou não são, ou nunca tinha pensado nisso?**

○ NUNCA PENSOU NISSO

○ NÃO PREOCUPAM **Porquê?** _____ (Explicar)

○ SIM PREOCUPAM **Porquê?** _____ (Explicar)

⟶ SE SIM, **Em que medida se preocupa com os mosquitos?**

MUITO POUCO - POUCO - MÉDIO - MUITO - MUITÍSSIMO

3. **Os mosquitos nascem fora das casas. Acha que sim, acha que não, ou não tem a certeza?**

○ ○ ○

4. **E nascem dentro de casa? Acha que sim, acha que não, ou não tem a certeza?**

○ ○ ○

5. **Na sua opinião, o que leva ao nascimento de mosquitos?**

a) Restos de comida no lixo ?	○ **SIM**	○ **NÃO**	○ **Desconhece / Talvez**
b) Animais de estimação (fezes e urina) ?	○ **SIM**	○ **NÃO**	○ **Desconhece / Talvez**
c) Vegetação (árvores, plantas)?	○ **SIM**	○ **NÃO**	○ **Desconhece / Talvez**
d) Recipientes com água (não tapados)?	○ **SIM**	○ **NÃO**	○ **Desconhece / Talvez**
e) Há outras causas?	○ **SIM**	○ **NÃO**	○ **Desconhece / Talvez**

⟶ SE SIM, **Quais?** _____

6. **No geral, qual a eficácia ou não, de cada uma das seguintes medidas para <u>controlar o número de mosquitos</u>** (repetir em cada alínea)**?**

	NÃO EFICAZ	MUITO POUCO eficaz	POUCO eficaz	RAZOÀVEL	MUITO eficaz	MUITÍSSIMO EFICAZ	Desconhece / Não tem a certeza
a) Aplicação de insecticida na rua							
b) Aplicação de Insecticida em casa							
c) Limpeza de lixos							
d) Esvaziar a água de pratos de vasos							
e) Criar peixes em lagos							
f) Utilização de raquete							
g) Esvaziar a água de recipientes ao ar livre							
h) Outros medidas, quais? _____							

7. **No geral, pensa que os mosquitos podem transmitir doenças?**

○ **SIM** ○ **NÃO** ○ **DESCONHECE**

SE SIM

a) Diga um exemplo de doença?

_____

b) Na zona onde mora, há mosquitos que podem transmitir doenças?

○ **SIM** ○ **NÃO** ○ **DESCONHECE**

SE SIM

b)' Que nome se dá a esse mosquito(s)?

_____

_____

b)'' Como o descreve?

_____

SE NÃO OU SE DESCONHECE

Já viu algum mosquito como este?

○ **SIM** ○ **NÃO**

SE SIM

Que nome lhe dá? _____

_____

8. **a) Em que medida concorda ou não, que em geral, quando se controlam os mosquitos em casa (e no quintal) contribui-se para controlar os mosquitos na rua/travessa/impasse da casa?**

DISCORDO TOTALMENTE – DISCORDO - INDECISO - CONCORDO - CONCORDO TOTALMENTE

b) E se controlar os mosquitos na sua casa, isso contribui para controlar os mosquitos na sua rua/travessa/impasse?

○ **DESCONHECE** ○ **SIM** ○ **NÃO**

9. **Já alguma vez ouviu falar ou leu sobre a DOENÇA "DENGUE" ?**

○ **SIM** ○ **NÃO** ⟶ SE NÃO, PASSA à pergunta 15

↳ SE SIM, **Como teve conhecimento?**

a) **Revistas ou jornais?** ○ **SIM** ○ **NÃO**

b) **Panfletos?** ○ **SIM** ○ **NÃO**

c) **Posters de Rua?** ○ **SIM** ○ **NÃO**

d) **Televisão?** ○ **SIM** ○ **NÃO**

e) **Rádio?** ○ **SIM** ○ **NÃO**

f) **Soube por outras formas.** **QUAIS?** _____

COMENTÁRIOS _____

10. **Como é que se pode apanhar a doença DENGUE?** (escreva todas as formas)

_____

_____

11. **Conhece algum pais do Mundo onde existe a doença Dengue?**

○ NÃO

○ SIM ⟶ SE SIM, **Indique um país** _____

12. **Quais os sintomas de quem fica doente com Dengue?**

_____

_____

13. **Na sua opinião há possibilidade de surgir ou não, a doença Dengue, na Madeira?**

○	○	○	○	○
Nunca tinha pensado nisso ou Desconheço	**É impossível**	**Pouco Provável**	**Muito Provável**	**Certo (vai acontecer com toda a certeza)**

14. Já alguma vez viajou ou viveu em algum país das Américas, África, Ásia ou Austrália?

- ○ **SIM** → SE SIM, **Qual (ais)? _____ Quando regressou? _____(ano)**
- ○ **NÃO** → SE NÃO, **E alguém da sua família ou amigos?**
  - ○ **SIM** → SE SIM, **Para que país(es)? _____**
  - ○ **NÃO**

CARACTERISTICAS SÓCIO-DEMOGRÁFICAS

SEXO **IDADE** ____ anos **Profissão: _____**

○ Masculino

○ Feminino

Até que ano estudou?

- ○ Não estudou
- ○ Até ao 4º ano (4ª classe)
- ○ Até ao 9º ano (5º ano do liceu)
- ○ Até 12º ano (Ensino secundário)
- ○ Licenciatura (Ensino superior)
- ○ Mestrado ou Doutoramento
- ○ Outro

Situação profissional:

- ○ Activo
- ○ Domestica
- ○ Nunca trabalhou
- ○ Reformada
- ○ Desempregado

IASAÚDE, IP-RAM

Inquérito sobre mosquitos aos residentes na ilha da Madeira

Nome do entrevistador:_____

Data:_____ Inquérito nº __CAB.SL1.002_____

0. Em que zona mora (freguesia, zona alta/zona baixa):

1. Na zona onde mora, os mosquitos picam-lhe?

○ NÃO ⟶ SE NÃO

○ SIM ⟶ SE SIM

2. Na zona onde mora, os mosquitos, são para si, um motivo de preocupação, ou não são, ou nunca tinha pensado nisso?

○ NUNCA PENSOU NISSO

○ NÃO PREOCUPAM

○ SIM PREOCUPAM

3. Na sua opinião, os mosquitos podem nascer fora das casas.

Acha que sim, acha que não, ou não tem a certeza?

○ ○ ○

4. E podem nascer dentro de casa? Acha que sim, acha que não, ou não tem a certeza?

○ ○ ○

5. Na sua opinião, o que leva ao nascimento de mosquitos?

a) Restos de comida no lixo ?	○ **SIM**	○ **NÃO**	○ **Desconhece / Talvez**
b) Animais de estimação (fezes e urina) ?	○ **SIM**	○ **NÃO**	○ **Desconhece / Talvez**
c) Árvores, plantas ?	○ **SIM**	○ **NÃO**	○ **Desconhece / Talvez**
d) Recipientes com água (não tapados)?	○ **SIM**	○ **NÃO**	○ **Desconhece / Talvez**

e) Há outras causas?

↳ _____

6. No geral, qual a eficácia ou não, de cada uma das seguintes medidas para <u>diminuir o número de mosquitos</u> (repetir em cada alínea)**?**

	NÃO eficaz	**MUITO POUCO eficaz**	**POUCO eficaz**	**RAZOÀVEL**	**MUITO eficaz**	**MUITÍSSIMO eficaz**	**DES CONHECE**
a) Aplicação de inseticida na rua (autoridades)							
b) Inseticida em casa							
c) Limpeza de lixos							
d) Esvaziar a água de pratos de vasos							
e) Utilização de raquete							
f) Esvaziar a água de recipientes ao ar livre							
g) Outros medidas, quais? _____							

7. No geral, pensa que os mosquitos podem ou não transmitir doenças?

○ **SIM** ○ **NÃO** ○ **DESCONHECE**

SE SIM

a) Diga um exemplo de doença?

_____

b) Na zona onde mora, há mosquitos que podem transmitir doenças?

○ **SIM** ○ **NÃO** ○ **DESCONHECE** SE SIM →

b) Na Madeira, há mosquitos que podem transmitir doenças?

○ **SIM** ○ **NÃO** ○ **DESCONHECE** SE SIM →

SE SIM

b)' Que nome se dá a esse mosquito(s)?

_____

_____

b)'' Como o descreve?

_____

_____

8. Em que medida concorda ou não com as seguintes afirmações ?
(para cada afirmação escolha a opção)

a) Quando se têm cuidados para diminuir os mosquitos em casa contribuímos para diminuir os mosquitos na rua dessa casa.

DISCORDO TOTALMENTE – DISCORDO - INDECISO - CONCORDO - CONCORDO TOTALMENTE

b) E se os cuidados que tem em sua casa, contribuem para que haja menos mosquitos na sua rua?

○ **SIM** ○ **NÃO** ○ **Desconhece / Talvez**

9. Já alguma vez ouviu falar ou leu sobre a DOENÇA "DENGUE" ?

○ **SIM** ○ **NÃO** ⟶ SE NÃO, PASSA à pergunta 15

↳ SE SIM, **Como teve conhecimento?**

a) Revistas ou jornais? ○ **SIM** ○ **NÃO**

b) Panfletos? ○ **SIM** ○ **NÃO**

c) Posters de Rua? ○ **SIM** ○ **NÃO**

d) Televisão? ○ **SIM** ○ **NÃO**

e) Rádio? ○ **SIM** ○ **NÃO**

f) Soube por outras formas. **QUAIS?** _____

COMENTÁRIOS _____

10. Como é que se pode apanhar a doença DENGUE? (escreva todas as formas)

_____

11. Conhece algum pais do Mundo onde existe a doença Dengue?

○ NÃO

○ SIM ⟶ SE SIM, **Indique um país** _____

12. Quais os sintomas de quem fica doente com Dengue?

_____

13. Na sua opinião a doença Dengue pode ou não ser grave?

○ SIM

○ NÃO

○ NÃO SEI

15. Na sua opinião a doença Dengue tem ou não tratamento específico?

○ SIM

○ NÃO

○ NÃO SEI

16. Já alguma vez tinha pensado ou nunca tinha pensado na há possibilidade de surgir outro surto de Dengue, na Madeira?

○ **Nunca tinha pensado nisso ou Desconheço**

○ **Já tinha pensado nisso**

a) Na sua opinião essa hipótese é:

○ **É impossíl**

○ **Provável/Pouco Provavel**

○ **Muito Provável**

○ **Certo (vai acontecer com toda a certeza)**

14. Na sua opinião, qual a possibilidade de haver mortes na Madeira causadas pelo Dengue?

○ **É impossível**

○ **Provável/Pouco Provável**

○ **Muito Provável**

○ **Certo (vai acontecer com toda a certeza)**

CARACTERISTICAS SÓCIO-DEMOGRÁFICAS (a preencher pela própria pessoa)

SEXO **IDADE** ____ anos **Profissão: _____**

◯ Masculino

◯ Feminino

Até que ano estudou?

- ○ Não estudou
- ○ Até ao 4º ano (4ª classe)
- ○ Até ao 9º ano (5º ano do liceu)
- ○ Até 12º ano (Ensino secundário)
- ○ Licenciatura (Ensino superior)
- ○ Mestrado ou Doutoramento
- ○ Outro

Situação profissional:

- ○ Activo
- ○ Domestica
- ○ Nunca trabalhou
- ○ Reformada
- ○ Desempregado

Já Teve Dengue? _____

Já respondeu a um questionário como este? _____

O que pensa destas intervenções que envolvem a comunidade?

_____

_____

Antes da reunião começar:

- Confirmar a presença de todos os participantes
- Ipod tem de ter bateria e espaço para gravar
- Cha e bolachas prontas na sala
- Nomes impressos em papeis (não atribuidos a nenhum lugar)
- Retirar cadeiras de perstigio (grandes) e eliminar posiçao de autoridade (cabeceiras)
- Bloco de notas para o observador

1. **Introdução**

Objectivo > discutir o combate doméstico ao mosquito

Regras /Consentimento (oral):

- privacidade dos participantes e confidencialidade do que é discutido
- uma pessoa deve falar de cada vez
- não rejeitar ou criticar os comentários dos outros participantes
- todos tem a mesma oportunidade de participar na discussão
- poderão desistir a qualquer momento

Apresentação e distribuição dos papeis de identificação

COMEÇAR A GRAVAR!

2. **Construção de entendimento** (5 minutos- se a primeira questão demorar muito tempo não avançar para a segunda)

- O que as preocupa na questão dos mosquitos?
- Qual a grande dificuldade em resolver o problema?

3. Discussão profunda 35 minutos. ´

Qual o risco de saude que os mosquitos poderão causar?
(Qual podera ser a consequência mais grave?) /
(Em que condições é que se pode morrer com dengue? (doenças cronicas? idade avançada, se já tive dengue?)
Há tratamento especifico(vacina ou um medicamento)? Porque?
Há pessoas que não são picadas? Porque? Há pessoas que não ficam doentes?
Quem poderá resolver este problema? (medicos, cidados, governo, autoridades de saude, turistas, etc)
Há alguma coisa que as autoridades de saúde poderiam fazer? O que é?
Há alguma coisa que os cidadãos possam fazer? O que?
Qual a importância do uso de insecticidas domesticos para combater os mosquitos?
Porque será uma das medidas mais usdas entre a população?
Qual a importância do uso de raquete electrica para combater os mosquitos? ´
Porque será uma das medidas mais usdas entre a população?
Onde nascem os mosquitos? Como se desenvolvem? O que é que precisam para se multiplicarem?
Que tipo de terrenos (agricolas, piscatorios, urbanos, florestais, pantanosos, etc)
Que tipo de casas terão mais mosquitos?
Corremos algum risco neste momento?
Quais são as condiçoes que uma região tem de ter para ter dengue? E para ter dengue mais que uma vez?
Poderá haver o aparecimento de novos casos? Como? Quando? Porque?
O que poderá levar ao aparecimento de mosquitos? Em que zonas da Madeira está o mosquito?

4. **Conclusão e Perguntas** 15 minutos
5. **Sorteio do vale e recolha do formulário com dados demográficos**

FOCUS GROUP SESSIONS CITATIONS
(BY CATEGORY, SUB-CHAPTER III.2 / STUDY 3)

(I) CONFUSION IN RISK PERCEPTION

Allergic reactions

«é normal, eu sou alérgica apicada de insetos, se eu levar uma picada de abelha, eu tenho que ir logo à urgência fico inchada, dá-me hematomas, na cabeça, no pescoço (…) isso preocupa-me imenso pelo facto de a minha própria filha (…) embora eu sei que ela não tenha alergia. Mas o mosquito de dengue anda por ai, e ela pode ser picada a qualquer momento, e eu como mãe, e eu penso que todos nós, temos aquela ansiedade»

Health consequences

«Preocupa as diferentes reações após a picada»; «… um caso de um rapaz que após ter sido mordido ficou anormal, ficou com sequelas irreversíveis.»; «esta filha desta minha amiga (…) ela apanhou isso, nunca mais ficou superada, ela nunca mais ficou igual. É uma miúda novinha com 25 anos mas que esta sempre com problemas»; «onde é que afeta mais normalmente é no fígado que afeta muito mais»; «Ao levar a picada, há pessoas que perderam a visão»;

Intrinsic protection to mosquito bite/DF

«….desde pequena nunca tive problemas. Antigamente tínhamos o engenho, montes de sujidade.»; «Eu tenho lá uma irmã, está lá há tantos anos e nunca apanhou e há outras pessoas que não apanharam, não quer dizer que eu também vá apanhar..»; «Eu sou muito picada (…) mas nunca apanhei»; «Eu não apanho gripes, por exemplo»; «algum componente no próprio sangue que faz se aproximar mais a umas pessoas do que outras»; «é falta de vitaminas»; «talvez pelo tipo de sangue»; «É o sistema imunitário»; «Se está mais baixo ou se está alto, se está fortalecido, tem vitaminas, se está forte, as doenças não

são transmissíveis tão facilmente do que quando temos o sistema imunitário...»

Gained protection to mosquito bite

«O mosquito (…) picava (…) fazia uma bolha e ficava vermelho a volta, não mas isso foi á quatro anos agora (…) nunca eu fui mordida»; «Mas de ano para ano, nota-se que o corpo também reagindo de forma diferente»; «Embora agora as reações de ano para ano são diferentes (…) agora já só dá comichão. Mas no início era terrível»

Disconsider DHF

«Desde que ela seja tratada a tempo e tratada devidamente cura-se»; «as pessoas que tiveram dengue estão curadas»; «mas ainda mais preocupa outras doenças que possam advir através do mosquito.»; «Outras coisas, a malária» ; «Porque no Brasil e a Venezuela, o dia-a-dia, deles é a dengue, e no entanto não há mortes, não há casos muito graves….»

Gained protection to DHF

«eu sei que chega a uma altura que há imunidade é adquirida com a própria população ….como acontece noutras latitudes e Venezuela.. »; «há outros países que vivem com este problema, mas também é verdade que eles também já têm imunidade, coisa que nós não temos ...»;

DF severity in Madeira

«*na Madeira não existe o verdadeiro dengue, o mosquito acasalou. Se houvesse já havia muita febre hemorrágica»; «por acaso lembro-me de ouvir falar do dengue no Brasil (…) fiquei horrorizada quando vi que o dengue hemorrágico matava (…) agora depois de eu ver o que vi, que não aconteceu nada disto»*

DF severity & personality, psychological stability

«Nem todas as pessoas que têm dengue hemorrágico morrem. Apenas aquelas que estão mais frágeis»; «se fosse picada talvez reagiria de outra maneira»; «Tenho uma amiga ela é extremamente magra, ela estava a passar uma altura difícil, o divórcio e estava mesmo em baixo e ela apanhou dengue ela disse que deu-lhe vômitos deu-lhe diarreia não tinha forças não se aguentava em pé, outra pessoa teve o dengue, outra pessoa minha amiga disse que foi como se fosse uma gripezinha, e um senhor com mais idade que é assim uma pessoa mais positiva pronto que deve se alimentar bem não é, ao contrário da minha amiga que estava muito débil devido a situação, ele diz que tinha uma febrezinha como se uma gripe não lhe deu nada em especial e o médico diagnosticou-lhe dengue»; «A pessoa fica deprimida, tudo pode influenciar o estado»;

DF severity & health status

«se a pessoa for mesmo doente e for mordida pelo mosquito pode ficar muito mal»; «Pessoas diabéticas podem ficar mal, nunca mais sara»; Eu preocupa-me com a idade que eu tenho e com os problemas que eu tenho de asma (…) se eu apanhar o dengue o que e poderá acontecer»; «Eu acho que há determinadas doenças que fragilizam já uma pessoa, e se calhar é esse o ponto muito mais importante.»; «Que varia consoante, há uma altura em que estamos melhores há uma altura em estamos piores»; «certas pessoas ficam mais vulneráveis, pessoas que estavam mais em baixo, ficavam de rastos com dores. E sem forças sem energia»; «Eu acho que as pessoas tem é que se cuidar, alimenta tomar vitaminas»; «depende do sistema imunitário de cada um, isso acho que é muito importante»

Risk of DF and/or DHF

«A minha preocupa-me que… a segunda vez, se for outra vez mordida, que é muito mais grave. …deriva para a hemorrágica. Até porque isto tem várias vertentes, parece. Este dengue, o ano passado foi um, mas este ano pode ser

outro…. Ainda é um pouco desconhecido»; «Porque também dizem que o dengue pode ter passado por elas e não ter reagido e não quer dizer que na próxima estirpe elas não possam reagir muito pior. Isso preocupa-me muito»; «Como as pessoas não têm muita informação, a primeira reação é pensarem " é uma gripe"; «Se calhar algumas pessoas tem menos tendência em ser picadas, mas todas as que são picadas tem risco de ter dengue….»

(II) DISBELIEF IN THE DOMESTIC SOURCE REDUCTION

Water is not related with mosquitoes

«Sempre houve águas estagnadas… não sei… e muitos poços.. e nunca houve esse mosquito»; «tiraram neste momento a lagoa está vazia, não é, também não é só por causa das águas paradas»; «agora isso dentro dele ou vai buscar ao exterior, é essa a parte que também n tenho muita…., se vai buscar as águas ou se é o próprio mosquito que o já tem, não sei»

Weather

«o nosso clima é propicio»; «A humidade. O nosso clima é propício a isso»; «gente sabe que alteração do clima, fez com que o bicho se instalasse cá na região, não vamos culpar nada nem ninguém.»

Trees

«As árvores, mais depressa as árvores»; «Mas aquelas palmeiras, aquelas palmeiras que existiam por aí, as palmeiras atraiam muito os mosquitos ali a volta»; « …e as tais árvores...»; «as próprias plantas»;«também esses recantos são situações onde nasce imensa erva»

Natural and public environments (large water collections)

«Também há "n" situações naturais que é quase impossível de evitar»; As águas estagnadas»; «as ribeiras»; «basta sair de casa ir, passa junto a ribeira para ser picado»; «As ribeiras tem mais propensão»; «No verão eles

vêm mais das ribeiras…»; «…as ribeiras também ficam paradinhas no verão»;

Semi-natural and agricultural environments (large water collections)
«portanto todos temos água de rega, chamada de água de rega, que vem da levada, e a levada às vezes entope, agua de rega às vezes entope com folhas de bananeira»; «que deve haver lá ou poços, ou seja la o que for, ou alguma levada»; «mesmo que tenha um vaso com água nunca iria acontecer uma grande reprodução de mosquitos, é mais nos tanques»; «Os poços destapados»; «As levadas de rega estão todas destruídas que é o caos»

Small-cattle production environments
«O grande problema são os animais domésticos, aquele porquinho, o coelhinho, (…) faz parte de uma cultura (…) hoje em dia com a crise mais se vira para a agricultura mais animais domésticos se vão ter. Há o coelhinho, há o porco, cria uma humidade e uma coisa ótima para os mosquitos se desenvolverem»

Absence of hygiene in public areas
«Ainda há despejo de entulho nas ribeiras, ainda há muito essa tendência»; «os esgotos estão destapados»; «São ruas que tem muitos esgotos cheiram muito mal, e que tem muitos mosquitos» ; «preocupa a falta de higiene, os caixotes dos lixos»

Domestic-source-reduction inefficacy
«Acha possível que isso aconteça? [talking about domestic aegypti-control]*»; «Eu fiz isso, tudo, tirei vasos, dos animais (…) tirei isso dos pneus»; «Apesar das medidas eles são sempre mordidos»;*

Domestic-source-reduction hard procedure

«Dificuldade em acabar com os mosquitos»; «num conjunto a prevenção global parece muito complicada»; «esta de tirar a água das plantas de flores, este tipo de flore se chove um bocadinho, a pessoas tem que estar muito em cima, muito pendente, para tirar a água»; «partilharam connosco águas paradas, tentar evitar, mas aquela sensação, que nem sempre é o suficiente»; «se podemos ter jarras, quanto tempo deve se mudar a água, o que é que é a verdade, se devemos deitar vinagre, se não devemos deitar vinagre»; «isso das plantas ... é difícil de tirar a água»;

Domestic-source-reduction vain efforts

«terrenos abandonados, que podem acumular agua e portanto servir de viveiros a mosquitos. e tem que haver uma intervenção, não sei muito bem como. os baldios e casas devolutas, podem criar mosquitos e a partir dai e não se pode controlar» ; «há casas abandonadas que têm águas estagnadas» ; «devia haver uma fiscalização» ; «como se faz no lixo, se uma pessoas não separar o lixo, leva uma multa brutal.... tem que se fazer inspeção...» ; «todas as coisas que não fossem cumpridas as pessoas apanhavam multa e pagavam mesmo forte e feio» ; «Tinha que haver uma autoridade para fiscalizar» , «eu tento fazer a minha parte, agora eu espero também que da parte do governo seja feito alguma coisa da parte deles»

(III) GOVERNMENTAL MISTRUST

Expectations on turnkey solutions and/or vertical solutions
(Misinformation about measures limitations and availability)

«No Brasil e a Venezuela, que convivem com isso diariamente eles devem ter alguma coisa que os protegem, que não esta coisa» ; «...medicamento que se possa importar...»; «Eu acho pouco devia de haver já uma vacina»; «Aquilo que eu vejo nos países tropicais é de bombar os tais inseticidas, e as áreas mais críticas eles passam a vida com.... bombar aquelas coisas todas...E nos

não fazemos nada disso» «…. A desinfeção»; «mas há muita coisa dessa que se pode ser minimamente vistoriado» ; «pulverizar as paredes com aqueles inseticidas como eles fazem no Brasil e Moçambique também…..»; « Deia haver apoio como houve com a mosca da fruta» ; «Posso dar um exemplo, tenho dois tanques ao pé da minha casa, poços, em que já fiz quatro participações na câmara e ninguém faz nada, e águas estão lá paradas»;

Governmental negligence

(Lack of awareness regarding governmental initiatives/outcomes)

«Infelizmente vieram das Palmeiras»; «Quando começou aparecer os grandes, disseram que vinham dessas palmeiras» ; «se tivessem se preocupado em consertar as levadas e dar uma ajuda às pessoas, aquelas que realmente não tinham possibilidades (…) por exemplo salvaguardar os seus poços e tapá-los, pela nossa bonita terra, ninguém teve esse cuidado, nenhum!» «começa pelas pessoas que têm responsabilidade geral» ; «[as autoridades fizeram algum trabalho]mas depois de já termos o mosquito» ; «se as entidades responsáveis por isto até hoje não tomaram uma posição de enfrentar isto como deve ser, isto é muito difícil começar por nós. Eu sei que nós estamos aqui de boa vontade e temos vontade que isto vá para a frente, mas se as pessoas que estão à frente de tudo disto não se puserem à frente isto não vai ao sítio.» ; «Quando começou o mosquito de santa luzia, houve tanta tanta coisa, que foi feita. O quê? Nada!» «não sei será política se será administrativa, que a ameaça não foi levada muito a sério»

Short dengue risk divulgation

«acho muito importante que as autoridades sanitárias tenham …..um papel muito forte (…) quem está por dentro, quem conhece, quem sabe o que é verdade, quem sabe que , aquilo que se estava a dizer, é preciso que saiba dizer às pessoas é preciso fazer isto, isto»; «Todas as pessoas deviam estar informadas para se prevenir e também se as pessoas estiverem informadas vão prevenir a sua casa e o resto da rua…»; «devia ser mais divulgado pela

população, devia haver apoio das autoridades, como fizeram na mosca da fruta…»; «eu acho que pouca informação foi dado em relação ao dengue»; «a população tem ser devidamente esclarecida»; «Podia-se ter feito mais ações de sensibilização junto das pessoas, em geral, informar»

Belief in home-made solutions

«Outro dia estive a ler não sei se é verdade senão» ; «Umas geleias que são receitadas pelas farmácias» ; «Chá de urtigas» ; «tomar levedura de cerveja, também é bom, porque ajuda a prevenir a picada de mosquito» ; «se fizermos uma infusão de urtigase depois regar as plantas com esse chá de urtigas, porque eles não gostam de urtigas e evita a desova nas plantas». «A mesma coisa que eles dizem da borra do café»; « também dizem no vaso, a borra do café» ; «Citronela, E mel, Lixivia» ; «fazer vitamina B durante seis meses e isso ajudava-me a prevenir as picadas e senti que a reação não era a mesma»

Community's role perception

«Não se pode esperar que ele [o governo] resolva o problema, temos de ser todos»; «eles têm feito um trabalho fantástico, eles têm andado porta-a-porta» ; «Acho que ninguém está livre de isso acontecer, se como se falou uma 2ª infeção pode ser mais grave, a verdade é que ninguém esta livre»; «aquilo de aparecer um novo serotipo e que torna a coisa ainda mais grave. Aquilo derive para dengue hemorrágico, o risco na última linha é morrer… é grave»; «não estou a dizer que nós não temos de nos proteger não foi isso que lhe quis dizer, eu acho que o mais importante é partir da outra prevenção e depois então;

TABLE III.2.1: RESULTS FROM DEDUCTIVE THEMATIC ANALYSIS.

Themes	*	Examples – in PORTUGUESE
MYTH 1- 'Mosquitoes do not transmit diseases'	-	
MYTH 2 - 'Mosquitoes only cause mild clinical consequences such as allergies, fever, etc.'	V	*«A cura no meu caso, do meu caso do meu filho, e muito difícil, é uma alergia muito grande»;* *«de pessoa para pessoa cria reações diferentes, e são mt graves, o meu filho (…)foi tao forte tao forte (…) As pessoas não tem noção do perigo»*
MYTH 3 - 'Dengue will not occur again in Madeira, it is very not likely'	-	
MYTH 4 - Since I do not feel the byte, I am not at risk of being bitten/infected'	V	*«...a preocupação que felizmente não é minha, acho que não foi picado (o meu sangue também e capaz de não ser muito bom)»;* *«Normalmente quando picam deixam marcas»;* *«Sei que há uns que são bastante mais picados que outros, acho q a probabilidade de ser picado também deve aumentar, se são mais picados a probabilidade é maior neles»*
MYTH 5 - Mosquitoes are allocated in a specific area and are not able to spread through the island'	V	*«Penso que isto é um problema mais de santa luzia»;* *«Agora também nem toda a Madeira, por exemplo em santa cruz, não tem havido e todos os casos que eu ouvi era só no Funchal»*
MYTH 6 - 'Dengue/*A. aegypti* was, finally, eradicated'	-	
MYTH 7 - 'Local health authorities are the key intervenient in the (domestic) control of mosquitoes'	V	*«Aquilo que eu vejo nos países tropicais é de bombar os tais inseticidas, e as áreas mais críticas eles passam a vida com…. bombar aquelas coisas todas...E nos não fazemos nada disso»;* *«mas há muita coisa dessa que se pode ser minimamente vistoriado* [pelas autoridades]*»*
MYTH 8 - 'Insecticides or other protective measures can control mosquitoes'	V	*«As redes nas janelas, os repelentes»* *«andar com os braços e as pernas tapadas»* *«começando por nós, por nos protegermos»;* *«convém pôr a rede na cama»*
MYTH 9 - 'I am (Community is) not an intervenient in the *aegypt*i-control'	V	*«mesmo que tenha um vaso com água nunca iria acontecer uma grande reprodução de mosquitos, é mais nos tanques»* *«gente sabe que alteração do clima, fez com que o bicho se instalasse ca na região, não vamos culpar nada nem ninguém»*

MYTH 10/11 - 'Clean houses or houses without animals do not have mosquitoes / Clean people have nothing to do concerning the control of mosquitoes'	*V*	*«Uma da razões são as águas, as limpezas, coisas acumuladas, lixos tudo isso»* *«as pessoas não pensam no dia de amanha, há muita sujidade»* *«portanto se não tivermos a higiene necessária, se nós oferecermos as condições ao mosquito ele desenvolve-se»*
MYTH 12 - By the usage of insecticides and/or flyswatter, I am already contributing to the *aegypti*-control	*V*	*«depois uma coisa que eu fiz, que dá resultado é que uso o biokill....»* *«Acho que se tem que tornar um hábito, deitarmos inseticidas em todo lado,… que é eficaz é»*