



Analysis of households private expenditure for protection against *A. albopictus* in Emilia-Romagna

Analisi delle spese delle famiglie per la protezione contro la zanzara A. albopictus in Emilia-Romagna

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Survey background and objectives (I)

- The scientific literature about the worldwide spread of *A. albopictus*, the related health threats for humans, animals and the environment, and the improvement of control methods has considerably developed in the last decades.
- But research on economic aspects of this global bio-invasion is still scarce, especially regarding basic information on costs supported by both the public administrations and the households for the protection against the mosquito.
- On this basis, after analyzing the costs of the control-and-prevention plan implemented by the Emilia-Romagna (ER) Regional Health Authority, we started a telephone survey on the ER households, in collaboration with the *ad hoc* Regional Working Group, , with the aim of collecting information about:



Survey background and objectives (II)

- The level of nuisance caused by the *A. albopictus* invasion in the population;
- The level of concern about the main health aspects of the invasion;
- The type of measures adopted by the households for protection against *A. albopictus* and related suitability and usefulness;
- The expenditure privately supported by households for such measures, in the perspective to assess the total private expenditure for protection against the mosquito in Emilia-Romagna;
- The influence on household behaviors from main environmental and social variables (e.g. type and location of dwelling house, level of education, number of household members, presence of children, etc.)



The questionnaire and the information collected

RESPONDENTS

- Sex
- Age
- Education level
- Principal buyer of anti-mosquito products

FAMILIES

- Number of cohabitants
- Presence of children (< 6 y. old)

HOUSE CHARACTERISTICS

- Typology (detached house/building/etc.)
- Floor level
- Presence of court/garden
- Use of court/garden
- Location (city centre/periphery/etc.)
- Municipality (altitude)

PERCEPTION OF INSECT NUISANCE AND EXPENDITURE

- Fly nuisance
- Expenditure for flies (Y/N)
- Wasp nuisance
- Expenditure for Wasps (Y/N)
- Nuisance from other insects
- Expenditure for other insects (Y/N)
- Ordinary mosquito nuisance
- Expenditure for ordinary mosquitoes (Y/N)

PERCEPTION OF TIGER MOSQUITO NUISANCE

- Tiger mosquito nuisance
- Expenditure for tiger mosquitoes (Y/N)
- Nuisance in the use of gardens/parks/etc.
- Scare for potential disease transmission

TIGER MOSQUITO EXPENDITURE

- Spray products (n./€/for tiger m. only)
- Tablets and other indoor electric diffusers (n./€/for tiger m. only)
- Coils and other outdoor repellents (n./€/for tiger m. only)
- Skin repellents natural/chemical (n./€/for tiger m. only)
- Various traps: electric, CO₂, ultrasonic, etc. (n./€/for tiger m. only)
- Larvicides (n./€/for tiger m. only)
- Other (n./€/for tiger m. only)
- Mosquito nets (year, €)

CONDOMINIUM INITIATIVES

- Y/N
- Type of interventions
- Expenditure (€)



Sampling

- According to the conditions of the survey (logistic, finance, etc.), the sample for the phone survey was randomly extracted from the population registries of ER Local Health Authorities (LHAs)
- The extraction followed 3 stratifications:
 - Territory of LHAs (situation before the year 2014)
 - Demographic size of municipalities (situation 1st Jan. 2014):
 - Municipalities with < 10,000 inhabitants;
 - Municipalities with between 10,000-50,000 inhabitants;
 - Municipalities with > 50,000 inhabitants;
 - Age of respondents (people born before 1st Jan. 1995) ;
- It was possible to extract 1,391 potential interviewees from the LHAs Romagna (former LHAs of Forlì, Cesena, Ravenna and Rimini), Imola, Bologna, Reggio Emilia, and Parma, representing 70% of the total population of the region



Sample distribution

- The extracted sample included adult population born before 1 Jan. 1995, distributed according to the distribution of the population in the territory of the selected LHAs and in the 3 categories of municipalities identified as shown in the below table.

| Population size of municipalities | Parma | Reggio | Bologna | Imola | Ravenna | Forlì | Cesena | Rimini | Total |
|-----------------------------------|------------|------------|------------|-----------|------------|-----------|-----------|------------|-------------|
| < 10.000 | 68 | 73 | 69 | 11 | 27 | 16 | 20 | 27 | 311 |
| 10.000 - 50.000 | 47 | 85 | 147 | 17 | 52 | 16 | 29 | 56 | 449 |
| > 50.000 | 85 | 76 | 178 | 31 | 98 | 53 | 44 | 66 | 631 |
| TOTAL | 200 | 234 | 394 | 59 | 177 | 85 | 93 | 149 | 1391 |



Interviews

The phone interviews progressed in parallel in the different categories of municipalities

-57 interviews were performed in 2015 collecting information related to year 2014;

-355 interviews were performed in 2017 collecting information related to year 2014;

In total, 412 interviews were collected with the territorial distribution shown in the below table

| Population size of municipalities | Bologna | Cesena | Forlì | Imola | Parma | Ravenna | Reggio | Rimini | Total |
|-----------------------------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|
| < 10.000 | 24 | 7 | 5 | 6 | 16 | 7 | 21 | 7 | 93 |
| 10.000 - 50.000 | 41 | 10 | 6 | 5 | 13 | 17 | 30 | 14 | 136 |
| > 50.000 | 48 | 12 | 16 | 11 | 22 | 32 | 22 | 20 | 183 |
| TOTAL | 113 | 29 | 27 | 22 | 51 | 56 | 73 | 41 | 412 |



Interviews (territorial distribution)

Distribution of interviews

| Population size of municipalities | Parma | Reggio | Bologna | Imola | Ravenna | Forlì | Cesena | Rimini | Total |
|-----------------------------------|--------------|--------------|--------------|-------------|--------------|-------------|-------------|--------------|---------------|
| < 10.000 | 3,9% | 5,1% | 5,8% | 1,5% | 1,7% | 1,2% | 1,7% | 1,7% | 22,6% |
| 10.000 - 50.000 | 3,2% | 7,3% | 10,0% | 1,2% | 4,1% | 1,5% | 2,4% | 3,4% | 33,0% |
| > 50.000 | 5,3% | 5,3% | 11,7% | 2,7% | 7,8% | 3,9% | 2,9% | 4,9% | 44,4% |
| TOTAL | 12,4% | 17,7% | 27,4% | 5,3% | 13,6% | 6,6% | 7,0% | 10,0% | 100,0% |

Distribution of population

| | | | | | | | | | |
|-----------------|--------------|--------------|--------------|-------------|--------------|-------------|-------------|--------------|---------------|
| < 10.000 | 4,9% | 5,3% | 5,0% | 0,8% | 2,0% | 1,1% | 1,5% | 1,9% | 22,4% |
| 10.000 - 50.000 | 3,4% | 6,1% | 10,6% | 1,2% | 3,7% | 1,1% | 2,1% | 4,1% | 32,3% |
| > 50.000 | 6,1% | 5,4% | 12,8% | 2,2% | 7,1% | 3,8% | 3,1% | 4,7% | 45,4% |
| TOTAL | 14,4% | 16,8% | 28,3% | 4,2% | 12,8% | 6,1% | 6,7% | 10,7% | 100,0% |



SURVEY RESULTS



Respondents and Households

| | Mean | Sd | Min | max |
|----------------|-------|-------|-----|-----|
| Respondent age | 55.76 | 16.88 | 19 | 90 |

| Gender | Freq. | Perc |
|--------|-------|--------|
| Male | 187 | 45.39 |
| Female | 225 | 54.61 |
| Total | 412 | 100.00 |

| Education | Freq. | Perc |
|---|-------|-------|
| Primary school | 45 | 10.92 |
| Lower secondary school | 106 | 25.73 |
| High school | 173 | 41.99 |
| Bachelor degree | 14 | 3.40 |
| Master degree or higher education level | 72 | 17.48 |
| (missing) | 2 | 0.49 |

| Children | Freq. | Perc | Average size | Median |
|-----------------------|-------|-------|--------------|--------|
| Families without kids | 344 | 83.50 | 2.60 | 2 |
| Families with kids | 86 | 16.50 | 3.79 | 4 |
| Whole sample | | | 2.79 | 3 |



Dwelling type

| House type | Freq. | Perc |
|---|-------|-------|
| Detached House | 84 | 20.39 |
| Apartment in multi-unit dwelling (2/3 apart.) | 86 | 20.87 |
| Apartment in building | 183 | 44.42 |
| Other house type | 59 | 14.32 |

| Location | Freq. | Perc |
|-----------------------------|-------|-------|
| Urban centre | 123 | 29.93 |
| Suburbs | 185 | 45.01 |
| Countryside near urban area | 85 | 20.68 |
| Other locations | 18 | 4.38 |

| External garden | Freq. | Perc |
|----------------------|-------|-------|
| House without garden | 60 | 14.56 |
| House with garden | 352 | 85.44 |



| Use of home garden | Perc |
|----------------------|-------|
| (Almost) never used | 29.46 |
| Weekly used | 27.48 |
| Often/prolonged stay | 43.06 |



Tiger mosquito annoyance

| Level of annoyance due to Tiger mosquitoes | Little / no annoyance | | Pretty annoyance | | Big annoyance | |
|--|-----------------------|-----|------------------|-----|---------------|-----|
| Whole sample | 26.70 | 110 | 31.5 | 130 | 41.75 | 172 |
| Household without kids | 29.94 | 103 | 32.56 | 112 | 37.50 | 129 |
| Household with kids | 10.29 | 7 | 26.47 | 18 | 63.24 | 43 |
| Difference statistically significant | | | | | | |
| Without external garden | 40.00 | 24 | 43.33 | 26 | 16.67 | 10 |
| With external garden | 24.43 | 86 | 29.55 | 104 | 46.02 | 162 |
| Difference statistically significant | | | | | | |



Level of eventual annoyance due to Tiger Mosquitoes in different house types

| Level of annoyance due to Tiger mosquitoes | Little / no annoyance | | Pretty annoyance | | Big annoyance | |
|--|-----------------------|----|------------------|----|---------------|----|
| Detached house | 23.81 | 20 | 30.95 | 26 | 45.24 | 38 |
| Multi-unit dwelling | 11.63 | 10 | 25.58 | 22 | 62.79 | 54 |
| Building | 36.07 | 66 | 32.24 | 59 | 31.69 | 58 |
| Other house type | 23.73 | 14 | 38.98 | 23 | 37.29 | 22 |

- The mean difference among samples is statistically significant only between apartments in multi-unit dwellings and apartments in buildings and between other house types and apartments in multi-unit dwellings.
- The correlation between the level of annoyance due to Tiger mosquitoes and the floor level where the apartment is located is negative and significant at 5% significance level (-0.1283). This means that the annoyance decreases with height, as expected.



Concern due to the vector ability of the Tiger Mosquitoes

| Level of concern | No/little concern | | Pretty concern | | Big concern | | Total | | |
|------------------|-------------------|-----|----------------|-----|-------------|----|--------|-----|--|
| Total | 42.82 | 176 | 42.58 | 175 | 14.60 | 60 | 100.00 | 411 | |
| Without kids | 46.65 | 160 | 39.94 | 137 | 13.41 | 46 | 100.00 | 343 | |
| With kids | 23.53 | 16 | 55.88 | 38 | 20.59 | 14 | 100.00 | 68 | |

- The mean difference is statistically significant.
- Moreover, the correlation between the level of concern and the level of education is not statistically significant.



TYPE OF PRODUCTS AND QUANTITY PURCHASED



Products purchased

| Types of products purchased | Purchased by (sample %) | |
|---|-------------------------|-----|
| Spray products for internal and external usage <i>Prodotti spray per uso interno o esterno</i> | 32.08% | 132 |
| Tables and other electric diffusers for internal usage <i>Piastrine o altri emanatori elettrici per uso interno</i> | 37.86 | 156 |
| Repellents for outdoor use (mosquito coils, vaporizers, essential oil diffusers) <i>Repellenti ad uso esterno, come zampironi, torce o emanatori di essenze</i> | 42.58 | 175 |
| Natural and chemical repellents for skin <i>Repellenti naturali ad uso cutaneo</i> | 62.53 | 257 |
| Electric, CO2, pheromone, suction, sensor-triggered, ultrasonic mosquito traps <i>Trappole elettriche o ad aspirazione, ad innesco, CO2 o ferormoni, o ad ultrasuoni</i> | 9.95 | 41 |
| Larvicides to be dissolved in drains and manholes <i>Prodotti larvicidi da sciogliere nelle caditoie e nei tombini</i> | 45.73 | 182 |
| Other/ <i>altro</i> | 1.46 | 6 |
| Adulticides / <i>Adulticidi</i> | 9.71 | 40 |
| After bite products / <i>Dopo puntura</i> | 3.88 | 16 |



Products purchased

| Quantity of products purchased per year (distinguished by type) | Median | sd | 25-75 percentiles |
|--|--------|-------|-------------------|
| Spray products for internal and external usage Prodotti spray per uso interno o esterno | 2 | 3.06 | 1-3.5 |
| Tables and other electric diffusers for internal usage Piastrine o altri emanatori elettrici per uso interno | 4 | 14.78 | 2-7 |
| Repellents for outdoor use (mosquito coils, vaporizers, essential oil diffusers) Repellenti ad uso esterno, come zampironi, torce o emanatori di essenze | 3.5 | 5.86 | 2-7.5 |
| Natural and chemical repellents for skin Repellenti naturali ad uso cutaneo | 2 | 4.10 | 1-3 |
| Electric, CO2, pheromone, suction, sensor-triggered, ultrasonic mosquito traps Trappole elettriche o ad aspirazione, ad innesco, CO2 o ferormoni, o ad ultrasuoni | 1 | 0.81 | 1-1 |
| Larvicides to be dissolved in drains and manholes Prodotti larvicidi da sciogliere nelle caditoie e nei tombini | 1 | 1.26 | 1-1.25 |
| <i>Adulticides / Adulticidi</i> | 1 | 2.04 | 1-3 |
| After bite products / <i>Dopo puntura</i> | 1 | 0.75 | 1-2 |



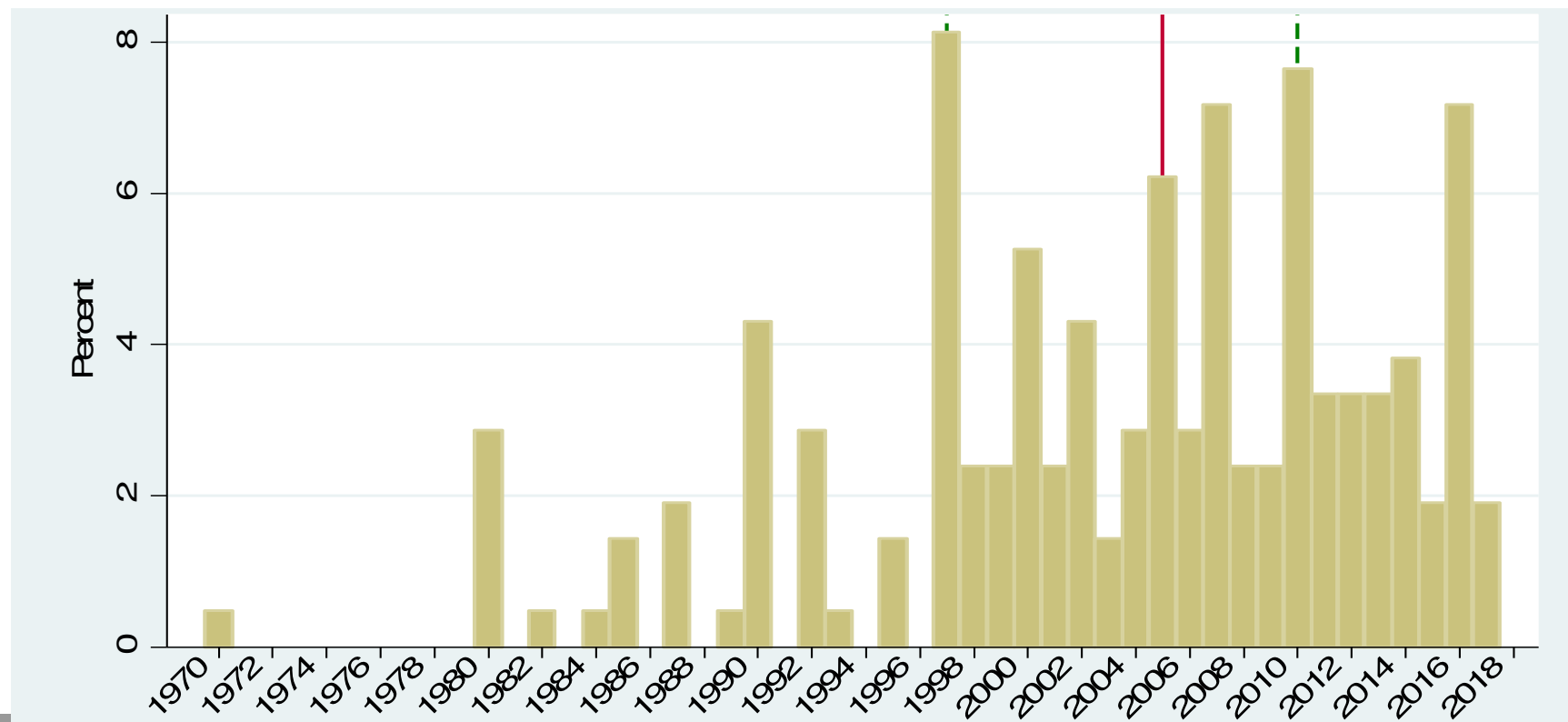
Products purchased

| Quantity of products purchased per year (distinguished by type) | Median without kids | Median with kids | Mean diff Stat. significant |
|--|---------------------|------------------|-----------------------------|
| Spray products for internal and external usage Prodotti spray per uso interno o esterno | 2 | 2 | No |
| Tables and other electric diffusers for internal usage Piastrine o altri emanatori elettrici per uso interno | 3.5 | 5.25 | No |
| Repellents for outdoor use (mosquito coils, vaporizers, essential oil diffusers) Repellenti ad uso esterno, come zampironi, torce o emanatori di essenze | 3 | 5 | No |
| Natural and chemical repellents for skin Repellenti naturali ad uso cutaneo | 2 | 2 | Yes |
| Electric, CO2, pheromone, suction, sensor-triggered, ultrasonic mosquito traps Trappole elettriche o ad aspirazione, ad innesco, CO2 o ferormoni, o ad ultrasuoni | 2 | 2 | No |
| Larvicides to be dissolved in drains and manholes Prodotti larvicidi da sciogliere nelle caditoie e nei tombini | 1 | 1 | Yes |
| Adulticides Adulticidi | 1 | 1 | No |



Mosquito nets

- 61.89% of the sample has mosquito nets in the windows (255)
- The average expenditure for nets is 983 euros (median 750)
- 50% of those who installed nets, did it before 2005





Condominium actions

- 23.30% of condominiums adopted measures to prevent/control tiger mosquitoes (96)
- Among those condominiums who adopted anti-tiger mosquito measures, they used:
 - 93.75% periodic larvicide treatments (*distribuzione periodica di prodotti larvicidi nelle caditoie/tombini dell'area condominiale*)
 - Action adopted by all the condominiums without garden and by 97.56% of condominiums with garden
 - 9.38% single anti-adult treatment (*intervento adulticida – nebulizzazioni nel giardino e/o nelle aree verdi*)
 - Action adopted only by 11.25% of condominiums with garden – none of condominiums without garden
 - 25.00% periodical anti-adult treatments (*interventi adulticidi a scadenza periodica programmata*)
 - Action adopted only by 28,05% of condominiums with garden – one condominium without garden (10%)
- Median expenditure per condominium → 20 euro per household (mean 47 euro)



Household expenditure to prevent/control tiger mosquitoes



Total expenditure per household

- **Expenditure per household**
 - Expenditure per product type: purchased quantity (stated) multiplied by average price
 - Sum of expenditure for all types of products, excluding adulticides (category i) and mosquito nets (being long-term assets)
 - The median quantity was used for those who claimed to use the product but did not state the amount used.
 - The mean prices used were obtained by dividing the declared expenditure by the quantity purchased.
 - On average, households spend **€48.11** (median expenditure **€26.16**)
- **Variety of products used**
 - On average 2.42 types of products (median 2, min 0 max 6)

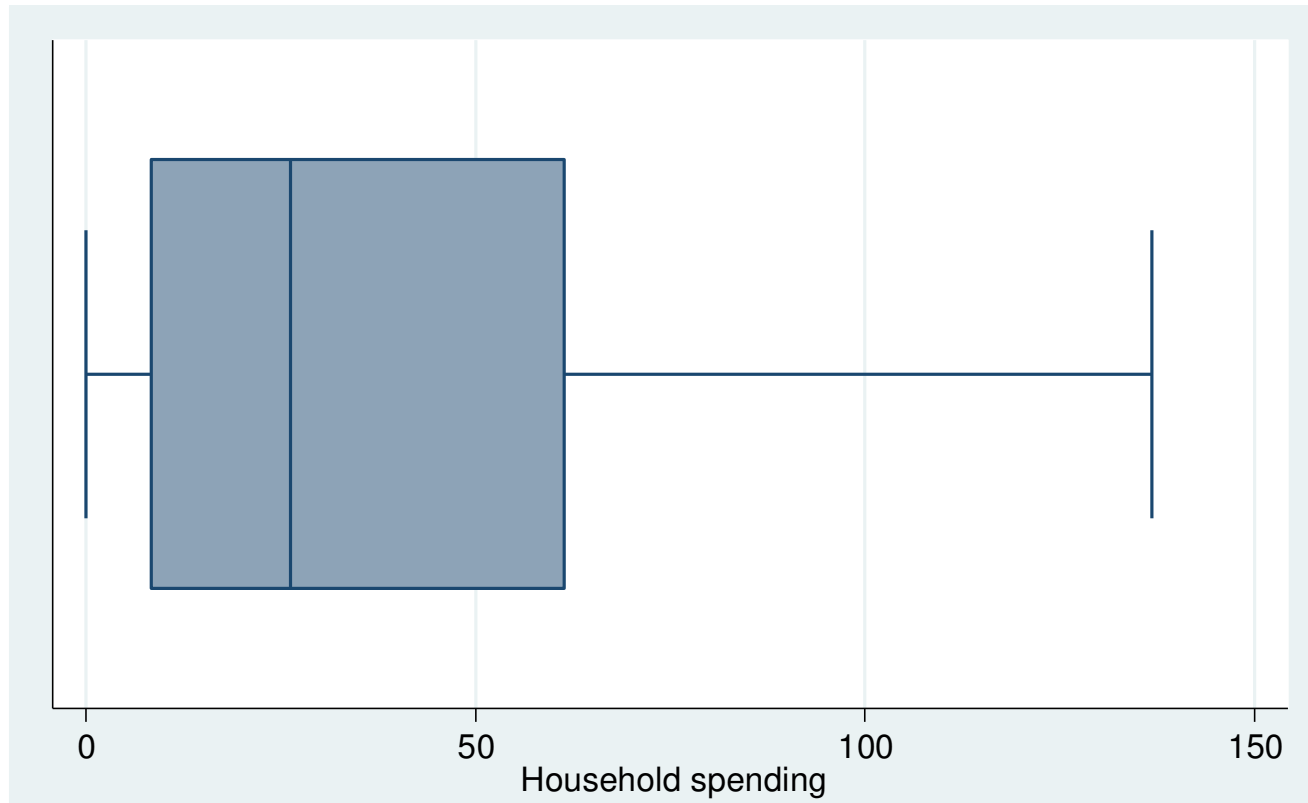


Mean and median price per product

| Mean and median price (per product type) | Mean | median |
|---|--------------|-------------|
| Spray products for internal and external usage <i>Prodotti spray per uso interno o esterno</i> | 6.10 | 5 |
| Tables and other electric diffusers for internal usage <i>Piastrine o altri emanatori elettrici per uso interno</i> | 4.40 | 4 |
| Repellents for outdoor use (mosquito coils, vaporizers, essential oil diffusers) <i>Repellenti ad uso esterno, come zampironi, torce o emanatori di essenze</i> | 4.07 | 3.42 |
| Natural and chemical repellents for skin <i>Repellenti naturali e chimici ad uso cutaneo</i> | 7.50 | 6.67 |
| Electric, CO2, pheromone, suction, sensor-triggered, ultrasonic mosquito traps <i>Trappole elettriche o ad aspirazione, ad innesco, CO2 o ferormoni, o ad ultrasuoni</i> | 39.96 | 30 |
| Larvicides to be dissolved in drains and manholes <i>Prodotti larvicidi da sciogliere nelle caditoie e nei tombini</i> | 3.72 | 0 |
| Adulticides / <i>Adulticidi</i> | 46.29 | 25 |
| After bite products / <i>Dopo puntura</i> | 10.75 | 10 |



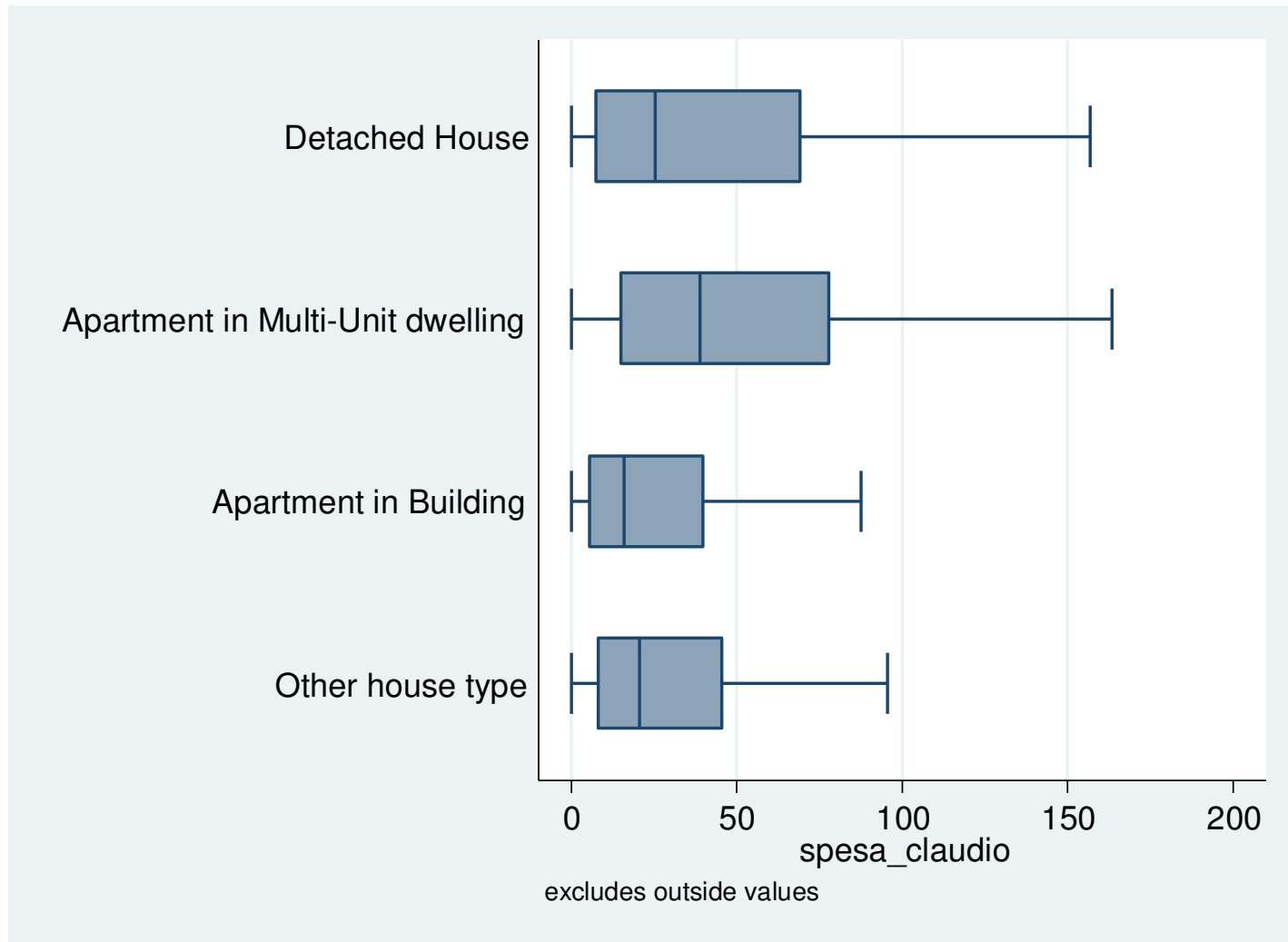
Mean expenditure per household



| | |
|-----------------------------|-------|
| Nr. Observations | 412 |
| Mean | 48.11 |
| Median | 26.16 |
| Sd | 68.97 |
| 25 th percentile | 8.30 |
| 75 th percentile | 61.44 |



Household spending distinguished by house type



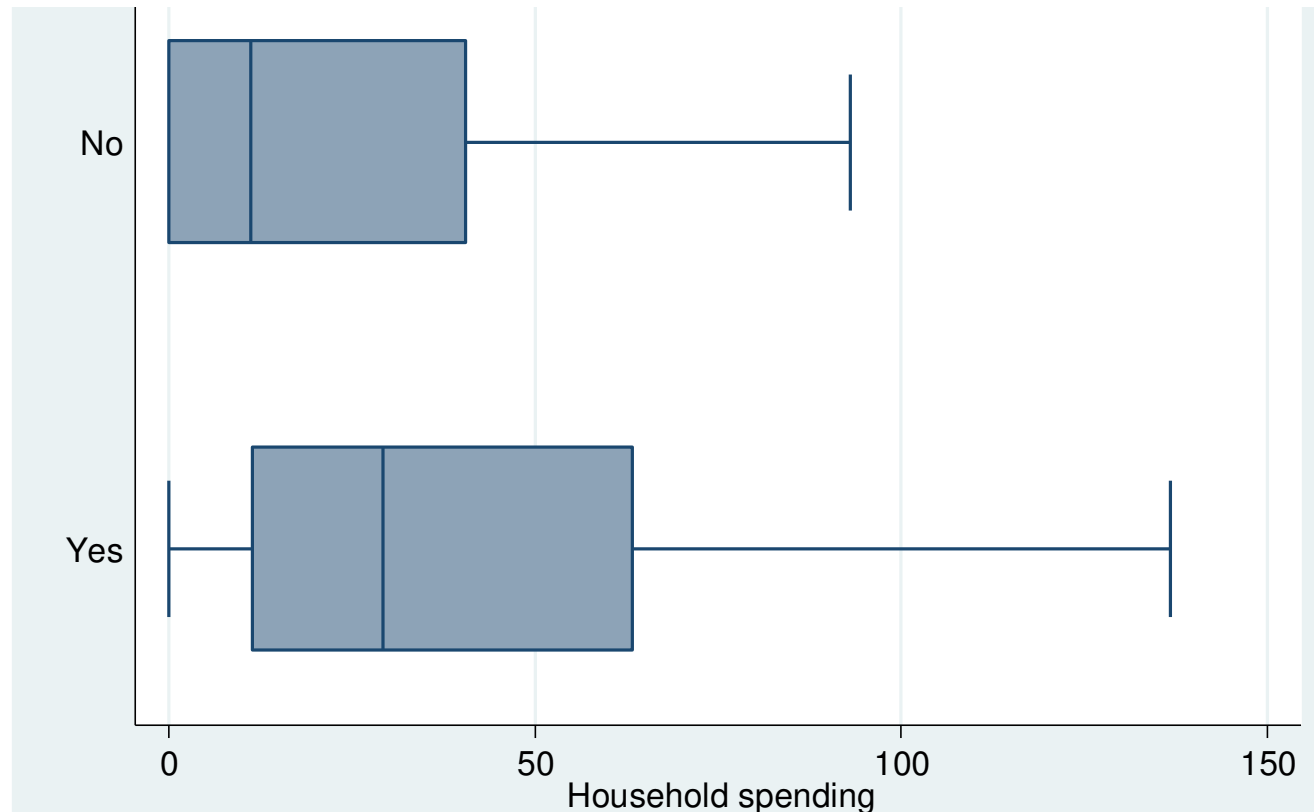


Household spending distinguished by house type

| house type | N | mean | median | sd | p25 | p75 |
|---|-----|-------|--------|--------|-------|-------|
| Detached House | 84 | 57.18 | 37.14 | 69.46 | 11.57 | 78.75 |
| Apartment in multi-unit dwelling | 86 | 58.54 | 43.85 | 52.04 | 21.42 | 86.21 |
| Apartment in Building | 183 | 36.28 | 18.18 | 50.31 | 7.50 | 47.47 |
| Other house type | 59 | 56.68 | 21.34 | 118.74 | 8.81 | 51.75 |



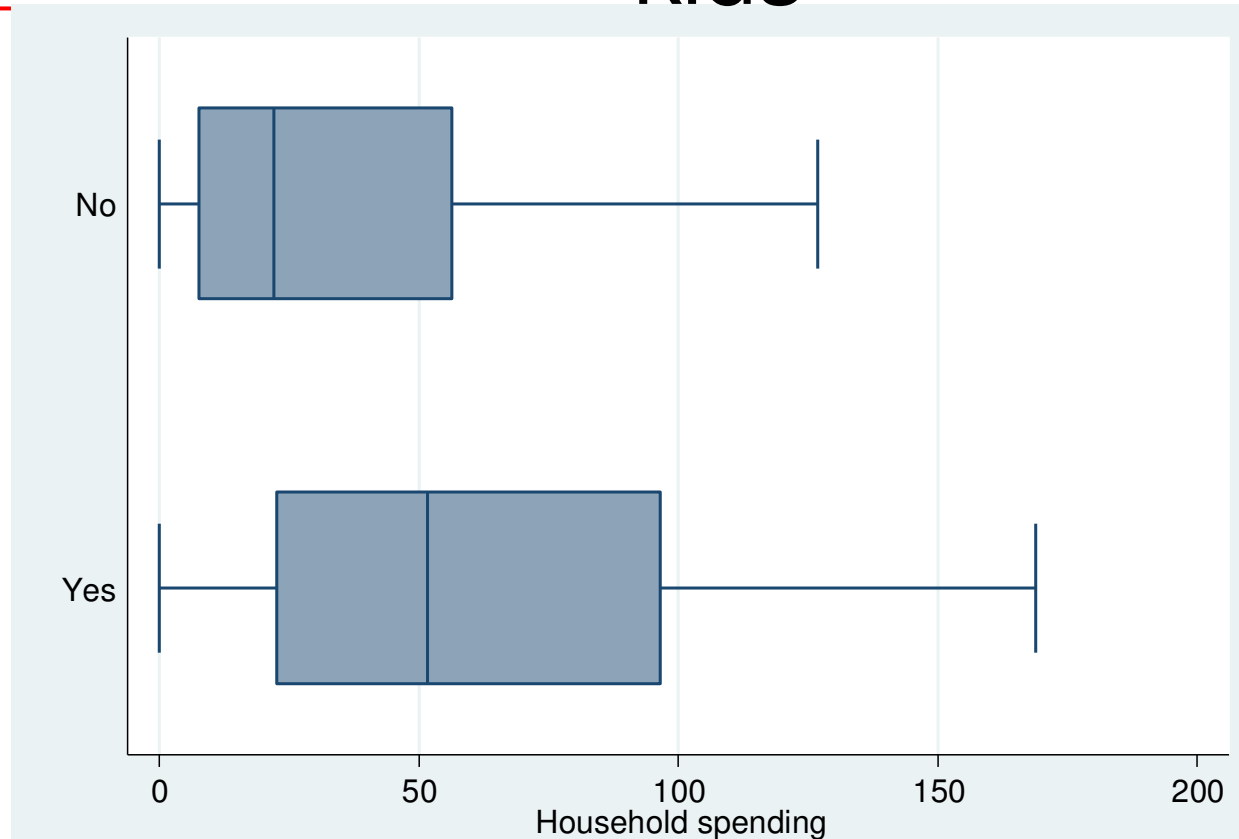
Household spending distinguished by external garden



| external garden | N | mean | p50 | sd | p25 | p75 |
|-------------------------|-----|-------|-------|-------|------|------|
| without external garden | 60 | 33.04 | 11.16 | 54.93 | 0 | 40.5 |
| with external garden | 352 | 50.67 | 29.18 | 70.84 | 11.4 | 63.4 |



Household spending with/without kids



| Kids under 6 | N | mean | p50 | sd | p25 | p75 |
|--------------|-----|-------|-------|-------|-------|-------|
| without kids | 344 | 43.29 | 21.98 | 65.45 | 7.50 | 56.42 |
| with kids | 68 | 72.48 | 51.64 | 80.83 | 22.55 | 96.56 |



Correlations

The pairwise correlation between household expenditure and...

- the floor level of the apartment is negative but not statistically significant (-0.0975)
- Level of use of the garden is positive and statistically significant (0.1410)
- Household size (# of members) is positive and statistically significant (0.1354)



Conclusions

- People are not sufficiently aware of the danger due to tiger mosquitoes
- Different behaviours of household living in different areas and in houses with different characteristics
- Presence of kids leads to higher expenditure
- Presence of garden or more intensive use of garden increase the expenditure in anti-tiger mosquito products