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The ant fauna of hospitals: advancements in public health and research priorities in Brazil

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ABSTRACT

Ants inhabit several types of natural and urban habitats, where they successfully nest. In urban environments, the hospitals should be considered priority for studies, as ants pose risks to human health due to their pathogen carrying potential. We aimed at surveying the literature about studies on ants in hospital settings in Brazil in the past 20 years. We found 40 papers in 22 journals, the first one published in 1993. Among them, 26 papers assessed pathogenic microorganisms on ants. We recorded 59 ant species, being *Tapinoma melanocephalum* the most common. The Minas Gerais and São Paulo states had the largest number of published papers. Mato Grosso do Sul and Rio Grande do Sul showed the highest number of species. Exotic ant species were recorded in all states, except Goiás. Considering the potential to carry microorganisms and the importance of thorough studies on the ecology of ant species, our results can support and guide further research in Brazil.

Introduction

The Family Formicidae is considered highly diverse and is among the most successful insect groups. Its members occur in almost all terrestrial environments (Wilson, 1987). Ants have varied diets, from predators to highly specialized species, and most build nests that vary from simple and small to complex and large (Hölldobler and Wilson, 1990; Longino and Hanson, 1995).

Ants raise the interest of scientists who study their ecological importance in ecosystems, because they play roles in nutrient cycling, soil aeration, pollination, seed dispersal, and food webs, as they make several trophic interactions (Del-Claro, 2012; Hölldobler and Wilson, 1990; Melo et al., 2012). In addition, some species have high economical importance, because of the damages they cause to crops, or because they harm humans (Della Lucia, 2003; Rust and Su, 2012). Ants of the genus *Solenopsis* Westwood, for example, can cause serious accidents with stings and bites, as their colonies are very populous (Drees et al., 2012) and easily found in Brazil (Zeringóta et al., 2014).

The ants known as tramp species live in close association with humans and are distributed all over the world, in particular in urban areas (Passera, 1994; Passera and Aron, 2005). Some species cause nuisance in several sites, such as households, schools, and gardens, and cause severe loss to food factories, restaurants, offices, and museums (Fowler and Bueno, 1998). Ant studies in hospitals have been raising great interest since the first reports made in England (Beatson, 1972) and Germany (Eicheler, 1990), due to the capacity of ants to carry pathogenic microorganisms (Bueno and Campos-Farinha, 1999), responsible for nosocomial infections. In Brazil, studies on ants in hospitals started recently in the 1990s (Fowler et al., 1993; Bueno and Fowler, 1994; Fowler et al., 1995b). Since then, the focus of these studies has been the ability of ants to explore hospital settings, and their association with bacteria and fungi.

Ant control in a hospital setting requires the use of specialized technologies, due to the particularities of ant foraging and nesting, as well as a need for constant monitoring. As a result, the conventional control form has temporary effects in most cases, because they eliminate only part of the colony. An efficient control method should be based on the complete elimination of the colony. Among current strategies, toxic baits stand out because the insecticide is incorporated in the feeding cycle of the colony (Bueno and Campos-Farinha, 1999; Bueno and Bueno, 2007). Therefore, studies on ant biology, behavior, and ecology in hospital settings are crucial to support efficient control methods.

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Hence, the objective of the present inventory was to survey the literature about ants in hospital settings in Brazil in the past 20 years. We aimed at advancing the knowledge of this issue through a discussion on research advancements and priorities.

Material and methods

We adapted the protocol proposed by Garcia and Lise (2013), who conducted a review on the association between ants and pathogenic microorganisms in hospitals in southern and southeastern Brazil. We carried out a systematic review, which allowed us to compile the current knowledge and tell apart information that is scientific from information that does not have solid support and requires further evidence.

The criteria for selection and inclusion of papers were: (i) papers that addressed the topic; (ii) papers indexed in the databases LILACS (Latin American Literature in Health Sciences), MEDLINE (Medical Literature Analysis and Retrieval System Online), and SciELO (Scientific Electronic Library Online), and (iii) papers published in journals within the defined time frame (from 1993 to 2014). The keywords used to search the databases were *ants* and *hospital*.

We recovered the following information from papers: focus of the study, site, duration, sampling methods, and number of ant species identified. Based on this information we made a map of the distribution of publications and properly identified ant species by state, and a table of ant species and collection methods used to sample them.

Results and discussion

We found 40 papers published in scientific journals, all resulting from empirical studies. The first paper on ants in a hospital setting in Brazil dates back to 1993 (Fowler et al., 1993), followed by another paper in 1995 (Fowler et al., 1995b). Then, there was a gap in publications until 2002, when a third paper was published. Since 2004, publication on the subject became more regular. The most productive years were 2009 and 2013, each with five papers published (Fig. 1; Table 1).

Most papers (n = 22; 55%) were published in the last six years (from 2009 to 2014) (Fig. 1). This concentration probably results from other research groups that recently started working on the topic in Brazil. We also observed that most publications (n = 32; 80%) identified the ant species collected, whereas only eight papers (20%) did not (Table 1).

The analysis of publication distribution in Brazil revealed an evident lack of papers on ants in hospital settings in the northern and northeastern regions, where for most states no papers in indexed journals have been published, or for which unpublished final course works, dissertations and theses have been produced. The states of São Paulo (n = 10) and Minas Gerais (n = 8) showed the highest number of papers (Fig. 2). These states belong to the core of science in Brazil, as they have most universities and research institutes, which played a vital role in starting the first studies and forming new research groups, which later spread the topic to other states.

We found papers in 22 journals, and the most frequent were: Neotropical Entomology (n = 6), Arquivos do Instituto Biológico (n = 5), and Revista da Sociedade Brasileira de Medicina Tropical (n = 5) (Table 1). The papers that investigated ant diversity were usually published in journals of Zoology and Entomology, such as Insect Science and its Application, Neotropical Entomology, and Sociobiology.

The articles that analyzed the association between ants and microorganisms were published in medical journals, such as Journal of Hospital Infection, Revista da Sociedade Brasileira de Medicina Tropical, and Revista de Patologia Tropical. However, we observed that some papers that focused on ant occurrences (Garcia et al., 2011; Gazeta et al., 2007; Fonseca et al., 2010) were also published in journals that traditionally publish studies in Human Health instead of Entomology, which shows the relevance of the topic for health. This phenomenon was reflected in the emphasis that the media (newspapers, magazines, and television programs) gave to this type of information (Bueno and Campos-Farinha, 1998; Fowler et al., 1995a; Garcia et al., 2011).

Most of the analyzed studies (n = 26) assessed the association between ants and pathogenic microorganisms, such as bacteria (n = 16; 61.5%), fungi (n = 3; 11.5%), and bacteria/fungi (n = 7; 27%) (Fig. 3). The pioneer study by Fowler et al. in 1993 already highlighted the concern about transmission of bacteria by ants in hospital settings, and since then most studies have assessed this topic. On the other hand, transmission of fungi by ants has been assessed only since 2005, with the publication of the study by Silva et al. (2005).

It is important to highlight that 14 studies (Bicho et al., 2007; Bragança and Lima, 2010; Carvalho et al., 2011; Cintra-Socowloski et al., 2014; Ferreira et al., 2008; Fonseca et al., 2010; Fowler et al., 1995b; Garcia et al., 2011; Gazeta et al., 2007; Pelli et al., 2013; Santos et al., 2002; Santos et al., 2009b; Zarzuela et al., 2002;) did not make microbiological assessments of ants in hospitals, but used an ecological-systematic approach to the species present in this kind

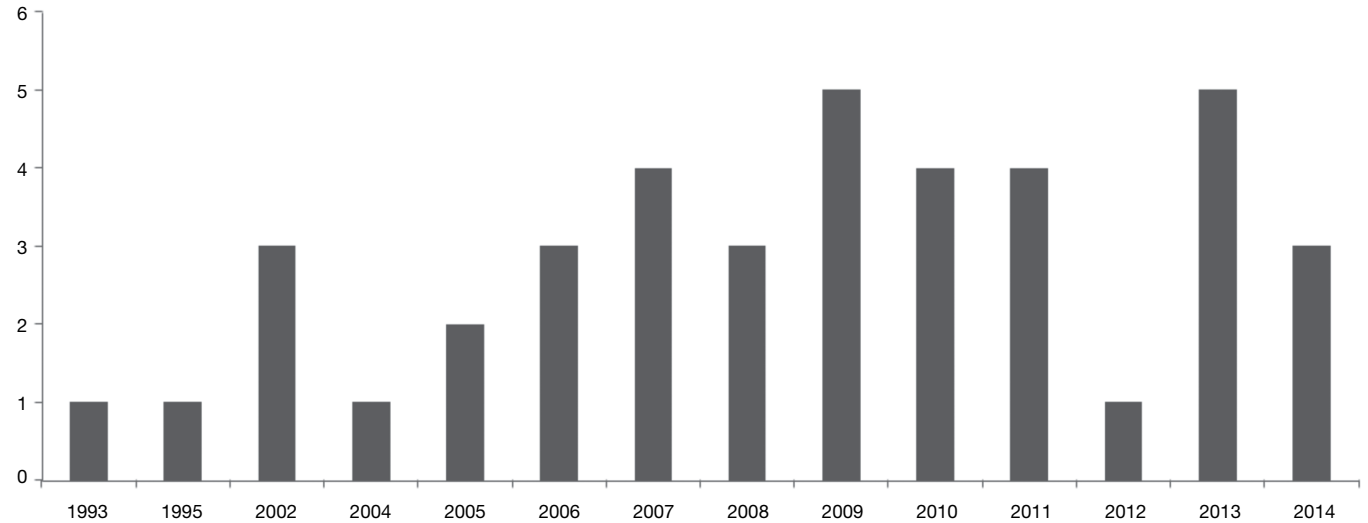

Figure 1. Number of papers on ants in hospital settings in Brazil published per year in national and international journals from 1993 to 2014.

Table 1.
Scientific papers on ants in hospital settings in Brazil from 1993 to 2014: author/year, journal, study site (state), study duration (months), sampling time, number of genera and species (D, diurnal collection; N, nocturnal collection; D/N, diurnal and nocturnal collection).

Author/year	Journal of publication	Study site (State)	Study duration (months)	Sampling time	Number of genera	Number of species
Fowler et al. (1993)	Insect Science and its Application	SP	-	-	11	14
Fowler et al. (1995b)	Naturalia	SP	-	-	4	8
Delabie et al. (2002)	O Biológico	BA	-	-	-	-
Santos et al. (2002)	O Biológico	MG	10	D/N	-	44
Zarzuela et al. (2002)	Arquivos do Instituto Biológico	SP	3	D/N	7	10
Cintra et al. (2004)	Revista Âmbito Hospitalar	SP	-	D/N	10	10
Moreira et al. (2005)	Neotropical Entomology	RJ	6	D	4	4
Silva et al. (2005)	Revista Médica de Minas Gerais	MG	5	N	3	-
Belei et al. (2006)	Nursing	PR	3	-	-	-
Costa et al. (2006)	Revista da Sociedade Brasileira de Medicina Tropical	MG	42	D	3	3
Lise et al. (2006)	Revista da Sociedade Brasileira de Medicina Tropical	SC	12	-	6	6
Bicho et al. (2007)	Arquivos do Instituto Biológico	RS	4	D	7	11
Gazeta et al. (2007)	Revista de Patologia Tropical	RJ	6	-	7	7
Rodovalho et al. (2007)	Neotropical Entomology	MG	-	N	2	2
Tanaka et al. (2007)	Arquivos Médicos do ABC	SP	-	-	2	2
Ferreira et al. (2008)	Sociobiology	MS	1	D/N	8	13
Pereira and Ueno (2008)	Revista da Sociedade Brasileira de Medicina Tropical	SP	6	-	-	-
Pesquero et al. (2008)	Neotropical Entomology	GO	9	D	8	9
Pantoja et al. (2009)	Journal of Medical Entomology	CE	12	D/N	5	13
Rando et al. (2009)	Arquivos do Instituto Biológico	PR	3	D/N	7	11
Santos et al. (2009a)	Revista da Sociedade Brasileira de Medicina Tropical	MG	6	D	8	10
Santos et al. (2009b)	Sociobiology	MS	2	D/N	9	15
Teixeira et al. (2009)	Neotropical Entomology	MG	13	-	1	1
Bragança and Lima (2010)	Neotropical Entomology	TO	6	D/N	9	12
Fonseca et al. (2010)	Acta Scientarium Health Sciences	MG	12	D	10	-
Fontana et al. (2010)	Neotropical Entomology	BA	-	D	4	4
Roxo et al. (2010)	Arquivos do Instituto Biológico	SP	-	-	2	2
Carvalho et al. (2011)	Revista de Biologia e Ciências da Terra	MA	12	D/N	8	-
Garcia et al. (2011)	Acta Scientarium. Health Sciences	RS	12	-	11	19
Gonçalves et al. (2011)	Arquivos do Instituto Biológico	RS	4	D/N	5	7
Santos et al. (2011)	Sociobiology	MS	10	D/N	14	21
Silva et al. (2012)	Revista de Patologia Tropical	MA	3	-	3	4
Aquino et al. (2013)	Journal of Hospital Infection	BA	12	D	11	12
Lima et al. (2013)	Revista da Sociedade Brasileira de Medicina Tropical	MA	12	D/N	10	14
Pelli et al. (2013)	SaBios: Revista de Saúde e Biologia	MG	13	-	8	11
Pereira and Ueno (2013)	Revista Biociências	SP	-	-	-	-
Vieira et al. (2013)	Revista Pan-Amazônica de Saúde	RO	4	-	1	1
Cintra-Socolowski et al. (2014)	Indoor and Built Environment	SP	36	-	7	3
Máximo et al. (2014)	BMC Research Notes	SP	12	D	5	1
Silveira et al. (2014)	Revista da Universidade Vale do Rio Verde	MG	-	D/N	2	-

of environment. Among these studies, ten were published in journals of Entomology or Health, such as Arquivos do Instituto Biológico, Biológico, Naturalia, Neotropical Entomology, Revista de Biologia e Ciência da Terra, SaBios: Revista de Saúde e Biologia, and Sociobiology.

Information on the duration of the study was present in 30 out of 40 papers analyzed. The studies were carried out in 1 to 42 months; on average, they lasted 12 months (Table 1). Among these studies, only four lasted more than 12 months, whereas in 18 studies the duration was shorter than the average. Therefore, there was no uni-

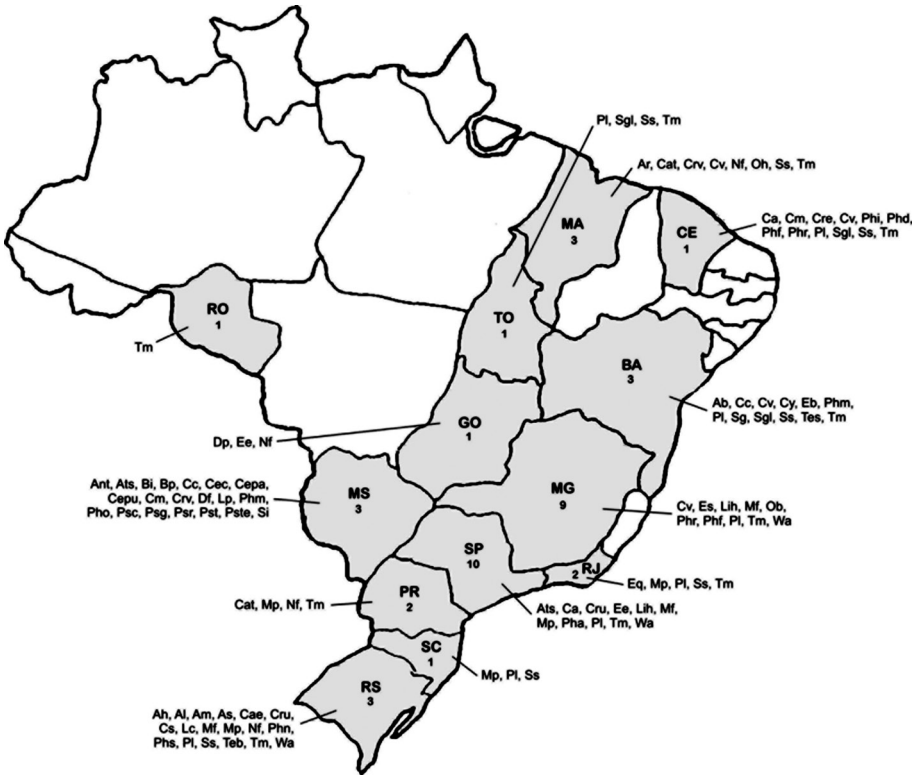

Figure 2. Ant species recorded in hospital settings and number of papers published per Brazilian state from 1993 to 2014. See Table 2 for ant species codes.

formity in the time spent in data collection, in spite of the need for standardization aimed at minimizing the bias caused by some variables. A good example is the influence of seasonality on variations in ant abundance and diversity in hospital settings, as reported by Carvalho et al. (2011), Lima et al. (2013), and Pelli et al. (2013).

There was also no standardization of collection time. Some studies carried out the collection only by day (n = 9), others only by night (n = 2), and some by day and night (n = 13), and 16 studies did not inform the time of collection.

We should take into account that the results of studies based only on diurnal collection may be underestimated, as there are ant species with exclusively nocturnal habits (Suiter, 2012), such as carpenter ants of the genus *Camponotus* Mayr. This information corroborates Silva et al. (2005) and Rodovalho et al. (2007), who collected only at night and recorded *Camponotus*. Surprisingly, no study provided substantial information on the habits (diurnal or nocturnal) of the collected ant species. This information is extremely important to decide the best control technique to be applied in the hospital setting.

Capture methods were also not standardized. The surveyed studies were based on attractive bait with carbohydrates and protein (n = 14), carbohydrates (n = 9), active search (n = 10), pitfalls (n = 1), and capture with vacuum cleaner (n = 1) (Table 2). Ten studies did not inform the collection method. Out of 30 studies that informed the collection method, 13 used more than one method, which may increase the chances of capture of a larger number of species. Attractive baits containing carbohydrates or protein sampled the largest species richness (Table 2).

Based on the studies that properly identified the ant species, 59 species of 23 genera were recorded in hospital settings in Brazil. The most common species were *Tapinoma melanocephalum* (Fabricius, 1793) (n = 20 studies), *Paratrechina longicornis* (Latreille, 1802) (n = 17), and *Solenopsis saevissima* (Smith, 1855) (n = 8). Most studies that identified ant species (27; 87%) recorded exotic species. Among the total of species identified, seven (11.5%) were considered exotic: *Linepithema humile* (Mayr, 1868), *Monomorium floricola* Jerdon, 1851, *Monomorium pharaonis* (Linnaeus, 1758), *P. longicornis*, *Pheidole megacephala* (Fabricius, 1793), *T. melanocephalum*, and *Tetramorium bicarinatum* (Nylander, 1846) (Table 2).

Half of the Brazilian states (n = 13) have no information on ants in hospital settings (Fig. 2). The states of Mato Grosso do Sul and Rio Grande do Sul had the highest number of species recorded (20 and 18, respectively), followed by Ceará and Bahia (with 12 species each), and São Paulo (11). Rondônia was the state with the smallest number of species (1 species). The ant *T. melanocephalum* had the broadest distribution and was absent only in the states of Goiás and Mato Grasso do Sul (Fig. 2).

Exotic species occur in most states, except for Goiás, but it can be a result of undersampling. The states of São Paulo and Bahia showed most records of exotic species (5 and 4, respectively); *P. longicornis* and *T. melanocephalum* occurred in both states (Fig. 2).

Considering the potential of ants to transmit pathogenic microorganisms, we highlight the importance of studies on the ecology of

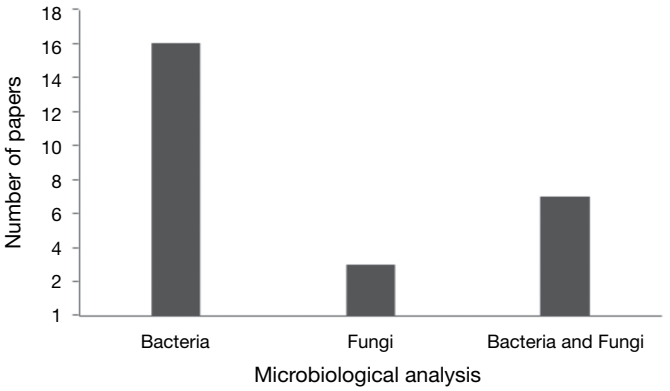

Figure 3. Number of papers published with a focus on microbiological analysis of ants in hospital settings in Brazil from 1993 a 2014.

Table 2.
Species, abbreviation code, collection method, and references of studies on ants in hospital settings in Brazil from 1993 to 2014 (A, carbohydrate bait; B, carbohydrate and protein bait; C, active search; D, pitfall; E, vacuum cleaner; *exotic species).

Species/Abbreviation[a]	Collection method	Reference
Acromyrmex balzani (Emery, 1890) - Ab	C	Aquino et al. (2013)
Acromyrmex heyeri Forel, 1899 - Ah	C	Bicho et al. (2007)
Acromyrmex lundii (Guérin-Méneville, 1838) - Al	C	Bicho et al. (2007)
Acromyrmex niger (Smith, 1858) - An	-	Garcia et al. (2011)
Acromyrmex rugosus (Smith, 1858) - Ar	B	Lima et al. (2013)
Acromyrmex striatus (Roger, 1863) - As	C	Bicho et al. (2007)
Anochetus targionii Emery, 1894 - Ant	A	Santos et al. (2009b); Santos et al. (2011)
Atta sexdens (Linnaeus, 1758) - Ats	A	Cintra-Socolowski et al. (2014); Santos et al. (2011)
Brachymyrmex incisus Forel, 1912 - Bi	A	Santos et al. (2009b)
Brachymyrmex patagonicus Mayr, 1868 - Bp	A	Santos et al. (2009b)
Camponotus arboreus (Smith, 1858) - Ca	B	Fowler et al. (1993); Fowler et al. (1995b); Pantoja et al. (2009)
Camponotus atriceps (Smith, 1858) - Cat	B	Lima et al. (2013); Rando et al. (2009)
Camponotus crassus Mayr, 1862 - Cc	A/C	Aquino et al. (2013); Santos et al. (2011);
Camponotus melanoticus Emery, 1894 - Cm	A/B	Pantoja et al. (2009); Santos et al. (2011)
Camponotus renggeri Emery, 1894 - Cre	B	Pantoja et al. (2009)
Camponotus rufipes (Fabricius, 1775) - Cru	B	Fowler et al. (1993); Cintra et al. (2004); Garcia et al. (2011)
Camponotus sericeiventris (Guérin-Méneville, 1838) - Cs	-	Garcia et al. (2011)
Camponotus vittatus Forel, 1904 - Cv	B/C	Aquino et al. (2013); Lima et al. (2013); Pantoja et al. (2009); Rodovalho et al. (2007)
Cardiocondyla emeryi Forel, 1881 - Cae	B	Gonçalves et al. (2011)
Cephalotes clypeatus (Fabricius, 1804) - Cec	A	Santos et al. (2009b)
Cephalotes palustri De Andrade & Baroni Urbani, 1999 - Cepa	A	Santos et al. (2011)
Cephalotes pusillus (Klug, 1824) - Cepu	A	Santos et al. (2009b); Santos et al. (2011)
Crematogaster victima Smith, 1858 - Crv	A/B	Lima et al. (2013); Santos et al. (2009b)
Cyphomyrmex rimosus (Spinola, 1851) - Cyr	C	Aquino et al. (2013)
Dorymyrmex flavus McCook, 1879 - Df	A	Santos et al. (2009b); Santos et al. (2011)
Dorymyrmex pyramicus (Roger, 1863) - Dp	B/D	Pesquero et al. (2008)
Ectatomma brunneum Smith, 1858 – Eb[b]	C/E	Aquino et al. (2013); Gazeta et al. (2007)
Ectatomma edentatum (Roger, 1863) – Ee	B/D	Pesquero et al. (2008); Zarzuela et al. (2002)
Ectatomma suzanae Almeida Filho, 1986 - Es	A	Pelli et al. (2013)
Labidus coecus (Latreille, 1802) – Lc	-	Garcia et al. (2011)
Labidus praedator (Smith, 1858) – Lp	A	Santos et al. (2011)
**Linepithema humile* (Mayr, 1868) – Lih	B	Fowler et al. (1993); Santos et al. (2009a); Zarzuela et al. (2002)
**Monomorium floricola* (Jerdon, 1851) - Mf	A/B	Cintra et al. (2004); Cintra-Socolowski et al. (2014); Fowler et al. (1993); Fowler et al. (1995b); Máximo et al. (2014); Pelli et al. (2013); Santos et al. (2011); Zarzuela et al. (2002)
**Monomorium pharaonis* (Linnaeus, 1758) - Mp	B	Fowler et al. (1993); Garcia et al. (2011); Lise et al. (2006); Moreira et al. (2005); Rando et al. (2009)
Nylanderia fulva (Mayr, 1862) - Nf	B/C/D	Bicho et al. (2007); Garcia et al. (2011); Gonçalves et al. (2011); Lima et al. (2013); Pesquero et al. (2008); Rando et al. (2009)
Odontomachus brunneus (Patton, 1894) - Ob	A	Pelli et al. (2013)
Odontomachus haematodus (Linnaeus, 1758) - Oh	C	Aquino et al. (2013)
**Paratrechina longicornis* (Latreille, 1802) - Pl	A/B/C/E	Aquino et al. (2013); Bragança and Lima (2010); Cintra et al. (2004); Cintra-Socolowski et al. (2014); Costa et al. (2006); Fontana et al. (2010); Fowler et al. (1993); Garcia et al. (2011); Gazeta et al. (2007); Lise et al. (2006); Moreira et al. (2005); Pantoja et al. (2009); Pelli et al. (2013); Roxo et al. (2010); Silva et al. (2005); Tanaka et al. (2007); Zarzuela et al. (2002)
Pheidole aberrans Mayr, 1868 - Pha	B	Zarzuela et al. (2002)
Pheidole diligens (Smith, 1858) - Phd	B	Pantoja et al. (2009)
Pheidole fallax Mayr, 1870 - Phf	A/B	Pantoja et al. (2009); Pelli et al. (2013)
Pheidole impressa Mayr, 1870 - Phi	B	Pantoja et al. (2009)
**Pheidole megacephala* (Fabricius, 1793) - Phm	A/C	Aquino et al. (2013); Fontana et al. (2010); Santos et al. (2009b); Santos et al. (2011)
Pheidole nubila Emery, 1906 - Phn	B	Gonçalves et al. (2011)
Pheidole oxyops Forel, 1908 - Pho	A	Santos et al. (2009b); Santos et al. (2011)

Table 2.
Species, abbreviation code, collection method, and references of studies on ants in hospital settings in Brazil from 1993 to 2014 (A, carbohydrate bait; B, carbohydrate and protein bait; C, active search; D, pitfall; E, vacuum cleaner; *exotic species).

Species/Abbreviation[a]	Collection method	Reference
Pheidole radoszkowskii Mayr, 1884 - Phr	A/B	Pantoja et al. (2009); Pelli et al. (2013)
Pheidole spininodis Mayr, 1887 - Phs	B	Gonçalves et al. (2011)
Pseudomyrmex curacaensis (Forel, 1912) - Psc	A	Santos et al. (2009b)
Pseudomyrmex gracilis (Fabricius, 1804) - Psg	A	Santos et al. (2011)
Pseudomyrmex rochai (Forel, 1912) - Psr	A	Santos et al. (2009b)
Pseudomyrmex tenuissimus (Emery, 1906) - Pst	A	Santos et al. (2009b)
Solenopsis geminata (Fabricius, 1804) - Sg	C	Delabie et al. (2002)
Solenopsis globularia (Smith, 1858) - Sgl	A/B	Bragança and Lima (2010); Fontana et al. (2010); Pantoja et al. (2009)
Solenopsis invicta Buren, 1972 - Si	A	Santos et al. (2009b); Santos et al. (2011)
Solenopsis saevissima (Smith, 1855) - Ss	B/C	Aquino et al. (2013); Bicho et al. (2007); Bragança and Lima (2010); Gonçalves et al. (2011); Lima et al. (2013); Lise et al. (2006); Moreira et al. (2005); Pantoja et al. (2009)
**Tapinoma melanocephalum* (Fabricius, 1793) - Tm	A/B/C/E	Aquino et al. (2013); Bragança and Lima (2010); Cintra et al. (2004); Costa et al. (2006); Fontana et al. (2010); Fowler et al. (1993); Fowler et al. (1995b); Garcia et al. (2011); Gazeta et al. (2007); Lima et al. (2013); Lise et al. (2006); Moreira et al. (2005); Pantoja et al. (2009); Pelli et al. (2013); Rando et al. (2009); Rodovalho et al. (2007); Santos et al. (2009a); Tanaka et al. (2007); Teixeira et al. (2009); Vieira et al. (2013)
**Tetramorium bicarinatum* (Nylander, 1846) - Teb	B	Gonçalves et al. (2011)
Tetramorium simillimum (Smith, 1851) - Tes	C	Aquino et al. (2013)
Wasmannia auropunctata (Roger, 1863) - Wa	C; B	Bicho et al. (2007); Cintra et al. (2004); Fowler et al. (1993); Santos et al. (2009a)

[a] The abbreviations ahead of the scientific names correspond to those used in Figure 2.
[b] The species *Ectatomma quadridens* Fabricius, 1793, cited by Gazeta et al. (2007) is considered as a synonym of *Ectatomma brunneum* Smith, 1858, as proposed by Bolton (1995).

ant species in hospital settings. These studies should propose more efficient control methods, because weak methods can lead to population booms by reducing diversity and competition among species (Bueno and Campos-Farinha, 1999). In addition, one of the worst problems is probably the human behavior towards ants, which vary from extreme entomophobia, when ants are directly associated with hospital infections, to total disregard, when the society believes there is no need for effective ant monitoring and control (Cintra-Socolowski, 2007). Hence, our analysis may support and guide future studies on ants in hospital settings.

Finally, the routine of doctors and nurses at hospitals is complex and it focuses on patient care. Hence, there is a need for properly trained professionals to monitor and control ants and other pests in hospitals.

Conflicts of interest

The authors declare no conflicts of interest.

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