A critically appraised topic (CAT) to compare the effects of single and multi-cat housing on physiological and behavioural measures of stress in domestic cats in confined environments

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Abstract

Background: Domestic cats have evolved from solitary, asocial predators and whilst they may display social behaviours, they can still exist as solitary survivors. Over-population and relinquishment of pet cats are ubiquitous problems worldwide, and rehoming centres (also known as rescues/shelters) aim to ameliorate this by holding cats in confinement for a variable period until a new home is found. The provision of optimal housing for large numbers of cats in close confinement, such as in rehoming centres, is therefore inherently difficult. Under these conditions there is the potential for individuals to develop signs of physical and psychological ill health, and thus experience compromised welfare. Available information regarding housing practices that maximise welfare currently provides conflicting results, and as a consequence there are no unanimous housing recommendations. The aim of this study was therefore to review the evidence on the impact of single housing compared to multi-cat housing on stress in confined cats, as measured by physiological and/or behavioural outcomes. The review was conducted using a Critically Appraised Topic (CAT) format. A systematic search of electronic databases (CAB Abstracts, Zoological Records and Medline) was carried out to identify peer-reviewed literature comparing single and multi-cat housing in confined environments.

Results: A total of 959 papers were initially identified, six of which met sufficient criteria based on their relevance to be included within this review. All of the studies had significant limitations in design and methodology, including a lack of information on how groups were assigned, inconsistent handling and enrichment provision between groups, and lack of information on the socialisation status of cats.

Conclusions: Whilst some studies suggested that single housing may be less stressful for cats, others suggested group housing was less stressful. Several other important factors were however identified as potential mediators of stress within the different housing systems, and recommendations based upon these findings are presented.

Keywords: Cat, Feline, Stress, Housing, Welfare

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Background

Clinical scenario
Many cats are kept in captive environments such as rehoming centres (also referred to as rescues/shelters), often for indefinite periods of time. In trying to accommodate these individuals as optimally as possible, it is important that they are provided with suitable housing conditions, which aim to minimise exposure to stress in order to maximise welfare.

Whilst recommendations for the housing of the domestic cat in laboratories, rehoming centres and other facilities have been put forward [1-3], the strength of evidence in support of these recommendations is rarely considered critically, and can be contradictory. This study was conceived as part of the development of evidence-based guidelines on the housing of cats in such contained environments, specifically cat rehoming centres. The aim was to assess the evidence on whether housing cats singly as compared to groups of two or more in these types of environments results in changes to physiological and/or behavioural measures of stress, and therefore which system should be recommended as preferable in order to minimise stress.

Introduction

A recent survey of cat rehoming organisations within the UK estimated their total intake of cats over a 12 month period to be 156,826, and 70% of these organisations were usually or always operating at full capacity [4]. Unfortunately, the provision of optimal housing for such large quantities of cats within these environments is inherently difficult, and under such conditions there is the potential for individuals to develop signs of physical and psychological ill health.

As a species, *Felis catus* is thought to have originated from primarily solitary dwelling felids [5-7], and whilst populations of free living *F. catus* may reside in groups, they may also live independently [8-11]. The feline social system is therefore one of variability and flexibility. In cat colonies, social structuring, relationships and potential conflicts may be the result of complex interactions between age, gender, sex ratio, relatedness and individuality [12]. It is thought that the occurrence of group living and the subsequent population densities of free ranging cats are ultimately influenced by the abundance of food resources rather than an inherent need for protection or regular social contact/interaction *per se* [13-17]. In contrast to free ranging populations, group living in domestic companion cats may often take the form of temporary or transitory housing during a stay in a rehoming centre, or when living in a domestic home environment. In both contexts, individuals may have limited choice or control over the nature of their ‘group living’, especially when their environment prevents them from making the choice to live independently (for example, multiple cats kept in a single enclosure at a rehoming facility, or multiple cats kept strictly indoors in the home).

It is likely that most rehoming centres will contain diverse populations of cats of varied ages and temperaments. Some cats may be related or familiar with each other (which may facilitate more amicable relationships in certain instances [18]), but the majority are potentially unrelated and also unfamiliar. For many individuals, being forced to reside in close proximity to other cats under these types of conditions may result in stress, conflict and potentially compromised health and welfare [19,20]. Organisations caring for such animals often operate under conditions of limited resources of space, staffing, time and finances. Currently, there is conflict in which housing practices are recommended to maximise use of resources but simultaneously preserve a basic standard of welfare for the cats.

The aim of this study was therefore to review the evidence on the impact of single housing compared to multi-cat housing on stress in cats, as measured by physiological or behavioural effects.

Focussed clinical question

In [cats kept in confined environments] does [single housing compared to multi-cat housing] result in [changes in physiological and/or behavioural measures of stress]?

Methods

Search strategy

The search strategy included the use of three separate electronic databases; CAB Abstracts (1910 – present, via the Ovid interface), Zoological Records (1998 – 2007) and Medline (In-process & other non-indexed citations, 1946- present, via the Ovid interface). The search was conducted in October 2012.

After accounting for specific syntax associated with each database, each search had similar components (search terms are listed in Additional file 1) and all were searched as both keywords and subject heading terms, joined using Boolean operators. All references obtained were imported into Endnote, combined into a master database, and all duplicates (identified based on title, date published and authors) were removed.

Inclusion criteria

Studies were not excluded on any grounds of quality, only on relevance to the study aim. For inclusion, papers had to include:

- Domestic cats kept in an enclosed area from which they were unable to exit (omitting the domestic home), for example, rehoming centres, boarding catteries and laboratories.
Comparison of both single and multi-cat (i.e. two or more cats) housing conditions within a single study, with outcome measures that were either behavioural, physiological or both, and were classed as indicators of stress. Our working definition of stress was:

“an inferred internal state which denotes a real or perceived perturbation to an organism’s physiological homeostasis or psychological well-being”, as used by Ward et al. [21], and similar to that used by McEwen [22], as we felt it was appropriate to this context. However many other definitions exist [23-25], and in the present study papers were not included or excluded on the basis of this definition.

Original observed or experimental data.

Studies were also required to be peer-reviewed, with the full text available in English.

Screening process
Two stages of eligibility screening were carried out. The first stage was completed independently by two of the authors (LF and JS), and any references that clearly did not fit the eligibility criteria were excluded. After this, in stage two, the remaining references were screened again by all three authors. For this stage, full text was retrieved for any papers where the information contained within the abstract was deemed insufficient to make a decision upon eligibility. Where there was initial disagreement over eligibility, the papers were read and discussed until consensus was reached among the reviewers [26].

Critical appraisal
All remaining papers were independently appraised by all three authors, using critical appraisal tools developed by the Department for Emergency Medicine at Manchester Royal Infirmary (www.bestbets.org/) and used extensively in the literature [27-29]. These appraisals were then collated by the lead author (LF) into a summary table. All three authors re-checked this summary of evidence for consistency of interpretation.

Results
959 papers were initially identified. Following screening as in Figure 1, six papers fulfilled all of the inclusion criteria. The results of the appraisal can be seen in Table 1.

Summary of the evidence
The findings of the appraisals are summarised in Table 1. There was a lack of agreement overall as to whether single or multi-cat housing was associated with higher levels of stress. The majority of the studies (four out of six) showed no difference in stress levels between single and multi-cat housing [30-33]. However, one of these studies only compared single cats with those housed with one or two other familiar conspecifics and not with larger multi cat groups [33]. One study suggested that stress levels were higher in cats housed singly in barren environments as compared to singly and group-housed cats provided with varying levels of enrichment [34]. The final study included showed no difference in stress levels between single and group housing in socialised cats, but found that cats previously unsocialised to conspecifics showed fewer signs of stress when single housed [35].

There were significant limitations to all of the identified studies. These included differential treatment of the groups within the study. For example cats in the single housing conditions either had inconsistent handing [34], were exposed to their housing condition for a much shorter period of time [30,34], were deliberately given barren, non-enriched housing [34], or experienced a non-stable environment over the course of the study period [30], when compared with group-housed cats. Sample size calculation was performed in only one study
To investigate levels of stress in cats housed singly, in pairs and in groups.

To provide recommendations for the most suitable housing type for cats with known socialization status.

To compare stress levels for the most suitable housing type for cats with known socialization status in newly arrived cats to a longer-term control group.

Stress and adaptation of socialization and stress in cats (Felis silvestris catus) housed singly, in pairs and in groups in boarding catteries. 

Cat housing in rescue shelters: A welfare comparison between communal and discrete-unit housing.

The effect of housing and handling practices on the welfare, behaviour and selection of domestic cats (Felis silvestris catus) by adopters in an animal shelter.

Socialization and stress in cats (Felis silvestris catus) housed singly and in groups in animal shelters.

Stress and adaptation of cats (Felis silvestris catus) housed singly, in pairs and in groups in boarding catteries.

Table 1 Summary of appraisal of the six papers meeting the inclusion criteria of assessing single versus multi-cat environments on physiological and behavioural measures of stress in confined domestic cats

| Author, date and title | Study design | Stated aim of paper | Subjects | Environment prior to study |
|------------------------|--------------|---------------------|----------|---------------------------|
| Uetake and others [30] | Randomised controlled trial | To provide information on the minimum spatial requirement for singly caged cats in animal shelters | 6 cats between 2–15 years old residing in an animal shelter | All cats had previously been kept in a socially stable group environment for at least 7 months |
| Lichtsteiner and Turner [31]* | Controlled trial | The relevant aim was to determine “whether the urinary cortisol levels of the cats are related to environmental parameters…” additionally the cortisol levels of cats from private households were compared with shelter cats to check for an influence of location | Twenty-one shelter cats | All cats had lived in the shelter for at least 3 weeks and were considered “adaptable” |
| Fraser D [34] | Randomised controlled trial | To examine how different housing and handling conditions affected the welfare, behaviour, adoption rate and selection of individual cats by adopters | 165 cats entering an animal shelter | All cats had been in the shelter for at least 7 months |
| Ottway, D. S. & Hawkins, D. M. [33]* | Cohort | To test the hypothesis that, in long-term shelter care, cats housed communally with unfamiliar conspecifics experience higher levels of stress than do cats housed in discrete units, due to inappropriate and unstable social grouping | 74 cats residing in 2 animal shelters, randomly selected from the shelter population | All cats had been in the environment for at least 1 month |
| Kessler M. R. & Turner D. C. [35] | Randomised controlled trial | To provide recommendation for the most suitable housing type for cats with known socialization status | 169 cats between 1–8 years old residing within an animal shelter | Excluded: cats having been in the shelter < 1 month |
| Kessler M. R. & Turner D. C. [32] | Cohort | To investigate levels of stress in cats housed singly, in pairs and in groups | 140 cats between 1–15 years old, residing in a boarding cattery in 2 categories, plus a “control” group of 45 un-owned cats | Excluded: ill cats, “highly stressed” cats (in “control” group only) |

Table 1: Summary of appraisal of the six papers meeting the inclusion criteria of assessing single versus multi-cat environments on physiological and behavioural measures of stress in confined domestic cats.

The table includes details of the study design, stated aim of the paper, subjects, and environment prior to the study for each of the six papers. The information is provided in a structured format, making it easier to compare and analyze the studies.
Table 1 Summary of appraisal of the six papers meeting the inclusion criteria of assessing single versus multi-cat environments on physiological and behavioural measures of stress in confined domestic cats (Continued)

| Intervention/group definition | Outcome measures (refer to Table 2 for further information on measures) | Data collection period and frequency of relevant measures taken to assess stress. |
|-------------------------------|---------------------------------------------------------------|---------------------------------------------------------------------------------|
| All individuals were exposed either to small, medium or large single cages in varying orders, all without human social contact. This was compared with their baseline stress levels when previously group housed (it is assumed the group size at this point was six) | - Urinary cortisol: creatinine ratios | - Cats were exposed to each condition for six days, i.e. the study period was a total of 18 days |
| Two groups, comprising six and seven cats housed communally | - Urine cortisol: creatinine ratio on a single voided sample | - Behavioural observations made over 3 hours during the last 2 days in each of the different housing conditions |
| Four of these group-housed cats were removed from each group and housed singly for one week prior to being sampled | - Cat Stress Scores (CSS) | - Urine samples were collected in the morning and evening of each day and then averaged, repeated each day of the study period |
| Assigned to one of four housing conditions: | - Outcome of stay i.e. adopted, not adopted, euthanized or isolated for physical health reasons | - A single urine sample was taken for each cat on a convenience basis during the study period (14 days). |
| - basic single (minimal human interaction) | - Time to adoption | - The study period lasted 21 days |
| - enriched single (with consistent human handling and human interaction) | | - Cats were observed for 2 minutes each day, and assigned a Cat Stress Score for the first 10 days of the study period, however, not all cats were assessed for the full 10 days |
| - basic communal (eight cats per group), with consistent human handling and human interaction | | - Data on individuals was collected each day over 15 consecutive week days, however, it is unclear if all cats were sampled for full duration due to cat turnover during the study period |
| - enriched communal (eight cats per group), with consistent human handling and human interaction and extra hiding places and toys | | - Cats instantaneously scan sampled and assigned a CSS each day, every 30 minutes from 08:30 am to 15:30. All other behavioural data was collected via one-zero sampling in between each scan interval |
| In one shelter, individuals were already housed communally in one of three groups (either 33, 47 or 65 individuals per group) | | - Data collected over a 7 day period |
| In the other, 12 cats were housed in pairs and nine cats were divided into threes. These cats were previously socialised together or siblings. Additionally, 15 cats were housed singly | | - Cat-Stress-Score was assessed every 10 minutes during the first hour post placement into the test condition, then twice (within a 15-min interval) after 6 hours. For the following days, 2 observations were made in the morning and 2 in the evening |
| Cats housed in individual units or in a group enclosure (specific group sizes unspecified but at least >5) | | - Data collected over 14 days |
| “Control” cats (45) were living in six groups (size unspecified), which had been stable and un-altered for at least 2 weeks prior to the study | | - CSS were initially recorded after the first two hours of entry into the test environment and were then taken 4 times daily, each day, twice in the morning and twice in the evening |
| Boarding cats housed singly (60), in pairs (40) or groups (40) (each group size unspecified but at least >2) according to owner preference | | |

Data collection period and frequency of relevant measures taken to assess stress.

- Urine samples were collected from each cat on a convenience basis and then averaged, repeated each day of the study period.
- CSS taken 4 x daily
- CSS were initially recorded after the first two hours of entry into the test environment and were then taken 4 times daily, each day, twice in the morning and twice in the evening.

Reference:
Finka et al. BMC Veterinary Research 2014, 10:73
http://www.biomedcentral.com/1746-6148/10/73
| Key results                                                                 | Conclusion                                                                 | Main limitations |
|----------------------------------------------------------------------------|----------------------------------------------------------------------------|------------------|
| • Time spent in locomotion and solitary play were lower in individual cages than in group housing conditions | • The experience of cats being exposed to a rotation of individual cages of varying sizes for 18 consecutive days (6 days in 3 different cages) appears to be more physiologically stressing than when they are housed in a familiar group environment, with no intervention | • No sample size calculation, but sample size very small. |
| • Urinary cortisol:creatinine ratios were highly variable in group housing conditions | • Group versus single housing did not result in a significant difference in cortisol:creatinine ratios | • No blinding of observer |
| • No statistically significant differences between groups                      | • Cats in barren single housing had higher stress levels than cats in the other 3 housing types and lowest adoption rates | • Insufficient detail to determine if groups were comparable at baseline |
| • CSS were highest in the basic single housing treatment                      | • Whether cats are housed individually or with one to two other familiar conspecifics does not appear to differentially affect stress levels | • No blinding of observer |
| • These cats also had the lowest adoption rate.                               | • Housing cats in large groups appears to be more stressful than housing cats in discrete units (1–3 individuals in a single unit)** | • Insufficient detail to determine if groups were comparable at baseline |
| • No significant differences noted between other housing conditions           | • Cats which have not been previously socialised to humans may find the shelter environment more stressful than those accustomed to humans | • Non-random assignment of cats to groups |
| • Cats that were considered non-socialised with people had higher CSS levels than those considered socialised, irrespective of housing type | • Cats which are not successfully socialised to conspecifics may find group housing more stressful than those socialised to conspecifics | • Randomisation method not described |
| • Overall CSS scores were higher in cats housed communally than cats housed in discrete units alone or with previously familiar conspecifics. Highest scores were only seen in communal housing** | • Group housed cats had higher CSS when a cat considered non-socialised to conspecifics entered the group, compared to when a cat considered socialised with conspecifics entered | • Comparisons made between two very different types of cats |
| • Play and resting/sleeping in close contact with conspecifics were observed in more instances in cats housed in pairs or threes than in communal housing** | • Cats considered non-socialised to conspecifics had lower CSS during the first hour of the study and on the last two days when housed singly compared with group housing | • No sample size calculation |
| • Agonistic encounters were observed in more instances in communal housing than in discrete–unit housing** | | • No blinding of observer |
| • Cats considered non-socialised to conspecifics had higher CSS than those which were socialised to conspecifics, when housed in groups | | • Insufficient detail to determine if groups were comparable at baseline |
| | | |
Table 1 Summary of appraisal of the six papers meeting the inclusion criteria of assessing single versus multi-cat environments on physiological and behavioural measures of stress in confined domestic cats (Continued)

| Randomisation methods unclear | No detail of how cats were assigned to groups | Single cortisol: creatinine measure of uncertain significance | "Discretely-housed" cats could be housed singly, or in twos or threes with other cats they were previously socialised to. This limits the extent to which such comparisons meet the criteria of this CAT |
|--------------------------------|-----------------------------------------------|---------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| Inappropriate comparisons used – stable enriched social group versus relatively barren single housing with minimal human contact | Groups not treated equally – all but basic single received extra human interaction causing potential confound | Validity of the CSS as a measure of 'Stress' in cats (see Table 2) | Sample size relatively small considering 8 sub-groups analysed |
| Stress measures may have related to barren environment/ frequent changes to housing conditions, especially in cats accustomed to a stable group housing situation | No physiological measures considered | No detail of how cats were assigned to groups | The validity of Cat-Approach and Human-Approach-Tests is questionable based on the methods used, (Non-conformity between the two different measures used to assess whether cats were socialised with conspecifics and with humans led to 30% of individuals being excluded from the data analysis) |
| Behavioural time budgets potentially a crude form of measurement to assess stress | Main aims of this study were not related to the topic of the CAT | No physiological measures considered | Excluding individuals that were 'highly stressed' a potential confounder |
| Behavioural time budgets potentially a crude form of measurement to assess stress | No physiological measures considered | No physiological measures considered | Validity of the CSS as a measure of 'Stress' in cats (see Table 2) |

*The primary aims of this study were unrelated to the CAT question. However, a small sub-component of the study was relevant, and the critical review refers only to this portion.**

**This portion of the study relates to comparisons that did not meet the inclusion criteria of the CAT due to the way that data was concatenated prior to statistical comparison. Such results are however included because they are considered otherwise highly relevant to the topic of the CAT.
[33], and some of the studies involved very small numbers of cats, which in one case amounted to six cats each exposed to three different interventions [30]. In none of the studies was the assessor of the outcome blinded to the intervention.

Additionally, the diverse populations under study and variations in methodology complicate comparison. Group sizes in the multi-cat environment were variable, from 2 to eight [33,34]. The effect of population density was not assessed, as this information was not available for all studies; however this may clearly be a potential confounding factor. The previous social experience of the cats varied, with some cats living in established social groups [30], some having been assessed as non-socialised to other cats by shelter staff [35] and others with no known or stated history of socialisation. A cats prior social experience was identified by one study as a factor in its stress levels in group housing, and the same study showed that the introduction of an “unsocialised” cat to a stable group caused an increase in the stress levels of all of the cats under observation [35].

There were also substantial differences in duration of the data collection periods across all studies, ranging from a single instance [31] to fifteen days [34], which could have affected the extent to which the cats had the opportunity to habituate to their respective study environments, or resulted in some cats exhibiting acute and others chronic signs of stress.

Thus these studies may not be truly comparing single and multi-cat environments, so much as suggesting the presence of several other factors that may be equally important in determining stress levels. These include: how consistent handling and husbandry routines are [34], as well as the amount of environmental manipulation, such as changes in housing location and type, that the individual is exposed to [30]. In one study, stress levels in their stable, long-term and group housed control population were lower than in any other experimental condition (i.e. individual, pair and group) [32], suggesting that group stability (and presumably familiarity) were also important mitigators of stress levels.

Discussion

The majority of the studies did not find significant differences between single and group housed cats in regards to their stress levels. Whilst this may suggest that group size does not in fact impact upon the stress of confined cats in rehoming and similar environments, it is arguable whether this can be assumed unequivocally. This is due to the lack of overall agreement between studies, as indicated by the conflicting evidence found in two of four such studies [34,35], as well as the various confounding elements of study designs found throughout the reviewed papers. These included factors such as differential provision of enrichment or human contact between groups, differences in the cats’ socialisation and housing experience prior to the studies, and potential differences in sizes of groups in the group housing conditions. These results also suggest that a stable environment (both social and physical) may be an important factor in managing stress, and that some cats (such as those previously successfully socialised to conspecifics) may cope better in a multi-cat environment than those with little, or aversive previous experience of conspecifics. Therefore, when providing housing for cats, it is important to consider their likely prior social experience. When housing cats communally, keeping cats in large group sizes may also be more stressful than keeping them in smaller groups [33] although there is only a small amount of relevant data to support this, and it is possible that population density may also be a confounding factor.

Measuring stress in non-human animals is inherently difficult, and it is unlikely that any one measure can accurately capture how stressed an animal is [36,37]. However, the more separate (suitable) measures considered within a single study, the greater the potential for robustness. As there is no consistent definition used within the scientific literature for this term nor specific aetiology or prognosis for stress [23], it is important that where studies attempt to measure stress, a clear definition of this concept is given. This will facilitate in the ease of assessing the suitability of study methodology, as well as determining whether the main aims and objectives of a study have been achieved. All of the studies aimed to measure stress, but only one of them attempted to provide a clear definition of it [33]. Of the six papers that were critically appraised, only one study used both behavioural and physiological measures to assess stress [30] and only one used more than one set of behavioural outcome measures [33]. Only one study assessed whether the study cats were previously socialised with conspecifics [35], which again makes direct comparison between group housing conditions across the different studies difficult, because this appeared to influence the stress levels experienced by cats when housed in groups.

Comparison between the studies is further complicated by the variety of methods used to assess stress, all of which have their limitations (further details of these methods used are provided in Table 2). The duration of time over which individuals were exposed to specific housing conditions also varied considerably (both within and between studies). This affects the comparison of stress levels between cats under different housing conditions due to possible confounds of comparing cats which are acutely stressed (e.g. from being taken from stable enriched group housing to barren single housing) to cats which are chronically stressed, or to those that have
actually begun to habituate to their environment. The physiological and behavioural signs of acute as compared to chronic stress may vary [38,39] making it difficult to isolate the specific effects of the environment, from the effects of period of exposure, upon the stress levels experienced by cats. However, by implication, the acutely raised stress levels in some of the single housed cats may have been as attributable to the acute change in environment rather than to the actual housing condition itself.

Whether individuals have previous experience of the housing environment may also be another important mitigator of stress. Previous research indicates that cats that have been housed in rehoming centre environments previously may cope better under these conditions than those that have not [47]. It is unknown if any of the study populations within the appraised papers had been housed under such conditions before, but this may have been an important factor to consider.

### Conclusion

On the basis of the evidence available, the below recommendations for practice have been provided. It is
however important to consider the complex nature of stress, and the methodological limitations of the above studies, in relation to their ability to help us isolate and assess the effects of multiple and single housing alone on stress in cats (Table 1). There are also numerous other factors which have not been considered here, particularly disease control, which is also of great importance in rehoming centres [48-50]. These results should draw attention to the importance of other potential mitigating factors which may influence how stressful single or multiple housing can be for individuals, and suggest ways these may be utilised practically to improve the welfare of confined cats in these types of environments.

Recommendations for practice

- Especially where the previous social history of cats towards conspecifics is unknown, individuals should be housed singly, but with the appropriate environmental enrichment in place (e.g. places to hide and perch, toys, consistent positive human handling where appropriate).
- Cats should be exposed to as few environmental changes/manipulations as possible during their stay and husbandry routines should be as consistent as possible.
- If cats are to be housed in groups, they should ideally be housed together with other cats considered socialised to conspecifics.
- If cats are to be housed in groups, or with those that are initially unfamiliar, wherever possible, groups should have a stable composition (i.e. group members are not constantly changed).

Additional file

Additional file 1: Search terms used in constructing the CAT.

Competing interests
The authors declare that they have no competing interests.

Authors’ contributions
LF carried out data collection, coordination, analysis and interpretation of data as well as the drafting of the manuscript. SE contributed towards the analysis and interpretation of data as well as critical revision of the manuscript. JS conceived of the study, participating in its design and coordination, data collection and critical revision of the manuscript. All authors read and approved the final manuscript.

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