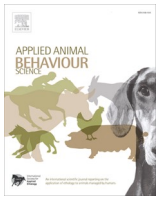
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Owner-reported experiences of transitioning cats from outdoor to indoor living

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ABSTRACT

An increasing number of people are choosing to keep cats indoors due to concerns for cat health and safety and to reduce cat-related pressures on native wildlife. However, limited research has been undertaken into the impacts of transitioning cats indoors on both owner and cat. The present study investigated owner perceptions and experiences of transitioning a cat with previous outdoor access to indoor-only living, through an online survey of 87 cat owners. Questions related to owner motivations and planning, experiences of the transition period, cat adjustment and perceived benefits and challenges. Participants most commonly cited cat safety as the motivating factor for, and perceived benefit of, keeping cats indoors. Participants reported facing practical and emotional challenges associated with the transition, such as struggling with doorway management and indoor litter maintenance, feelings of guilt over confining their cat, and concern about meeting their cat's needs. Participants generally reported increased financial burden associated with the transition indoors, with the exception of veterinary bills, which were reported to reduce. Over 40% of participants perceived that their cat had adjusted to indoor living within days, a quarter indicated adjustment occurred within weeks, while 12.6% reported that their cat had still not adjusted. Faster adjustment periods were reported where cats were younger at the time of transition. While most owners reported minimal changes in their cat's behaviour following transition, some reported increases in social behaviours such as play, vocalisation, and attention seeking. Only 13.8% of participants reported preparing for the transition prior to bringing their cat indoors, with 46% of participants reporting they made no preparations prior to transition, and 35.6% reporting an unplanned transition that was initiated due to a medical need or safety concern. Most participants reported implementing at least one housing modification during or after moving their cat indoors to support the transition. The majority of participants found the transition easier than expected, perceived their cat as happy post-transition, and stated that they would keep future cats indoors. Owner experiences reported in this survey provide valuable insights to inform future indoor cat management initiatives, and to provide support for those who choose to transition their cat indoors, when indoor management is an appropriate and viable.

1. Introduction

Unrestricted outdoor access is a common part of domestic cat husbandry in many parts of the world (Jongman, 2007; Tan et al., 2020). However, recent shifts in public sentiment have led many cat owners in countries such as Australia and New Zealand to restrict their cats' outdoor access and, in many cases, keep their cats exclusively indoors (Foreman-Worsley et al., 2021). Such shifts have been influenced by increased awareness of the outdoor risks to cat health and safety (Foreman-Worsley et al., 2021; Ovenden et al., 2024), and heightened concern for native wildlife (McLeod et al., 2019). Outdoor risks to cat welfare are numerous and include: increased risk of experiencing vehicular trauma, injury, inter-animal conflict or predation, and heightened exposure to diseases and parasites (Nation and St. Clair, 2019; Machado et al., 2021; Arhant et al., 2022; Tan et al., 2020). At the same time, cats themselves pose a potential risk to vulnerable wildlife

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populations. The presence of free-roaming cats has been shown to affect the health, mortality, behaviour, movements, and activity schedules of native wildlife, and has the potential to transmit pathogens known to have zoonotic potential and cause disease in wildlife (Loss et al., 2022).

For cats with current outdoor access, whose owners choose to bring them indoors, this change in housing and management will require a gradual or instantaneous transition from pre-established unrestricted or semi-restricted outdoor access to an indoor-only environment. To date, limited research has been conducted into transitioning cats indoors and important questions remain about how a transition to indoor-only living may impact cat welfare, owner satisfaction and wellbeing, or how to best support both owner and cat for a successful transition (Railton et al., 2025).

Previous research indicates that cats are highly adaptable to a multitude of environments and living conditions (Budiansky, 2015; Jongman, 2007; Natoli et al., 2022) and that suitable husbandry can be achieved within an indoor environment if key needs are met (International survey: Foreman-Worsley et al., 2021; Meta-analysis: Foreman-Worsley and Farnworth, 2019; Review: Herron and Buffington, 2010; Review: Jongman, 2007). Further, initial research suggests that the majority of cats are likely capable of successfully transitioning to a life indoors, even those with previous unrestricted outdoor access (Railton et al., 2025).

However, while the majority of cats may adapt relatively easily to indoor-only living, owners may find the transition more challenging. In a recent study that contemporaneously followed owners and cats before, during, and after an indoor transition, some owners struggled with the logistical and lifestyle changes necessary for the transition (Railton et al., 2025). Participants cited issues with escape attempts, difficulty ensuring household and visitor compliance with keeping cats inside, feelings of guilt over cat restriction, and trouble balancing their own thermal comfort with the need to keep doors and windows closed (Railton et al., 2025). Importantly, at the cessation of this study, despite the majority of cats adapting well, most participants reverted to giving their cat outdoor access, highlighting the importance of considering both human and cat factors in indoor cat management strategies (Railton et al., 2025).

Previous research into cat welfare during confinement has often focused on cats in shelter settings or assessed static differences between indoor and outdoor cat populations (Foreman-Worsley and Farnworth, 2019). In contrast, the process of transitioning indoors, and the experiences of owners and cats during this period, are currently under-researched. Previous findings emphasise that indoor transitions are both a human and animal process, in which owner beliefs, emotions, and household practices play a central role in determining outcomes (Foreman-Worsley et al., 2021; Railton et al., 2025). Considering the influence of human experiences and beliefs on transition outcomes and cat welfare in general, it is crucial that research addresses this gap.

The present study aims to gather information on owner motivations for transitioning cats indoors, their perceptions of the transition process, the benefits, and the challenges encountered. By examining owner-reported experiences, this study provides insight into factors that may influence both cat welfare and owner satisfaction during indoor transitions, and to inform strategies that support successful and sustained indoor-only management.

2. Methods

2.1. Ethics

This study was approved by the Eastern Institute of Technology Human Research Ethics Committee (EA21241002) as an amendment to a related study focused on transitioning cats indoors (Railton et al., 2025). The survey, hosted on SurveyMonkey, was open for responses between the 2nd of December and the 8th of December 2024. Informed consent was obtained through the survey platform prior to participants commencing the survey. Participation was voluntary and participants could withdraw at any time. Participant response data was stored securely on the SurveyMonkey platform (San Mateo, CA, USA) with two-factor authentication enabled. Anonymised data was transferred to Companion Animal New Zealand's (CANZ) secure server (Microsoft SharePoint).

2.2. Survey Design

A cross-sectional, retrospective survey was designed to capture cat owners' experiences with transitioning their cats from outdoor access to indoor-only living. Survey questions (Supplementary Materials S1) included cat demographics (age, sex, outdoor access history), transition details (age at transition, preparation time, duration of adjustment), motivations for transitioning (e.g., safety concerns, health issues, veterinary advice, wildlife protection), sources of information used during transition (e.g., veterinary advice, online research, books, social media), cat behavioural changes observed (vocalisation, attention-seeking, play, sleeping, scratching, aggression, eating, grooming, toileting habits), environmental modifications made (e.g., scratching posts, vertical furniture, litter boxes, catios), financial impacts (veterinary expenses, equipment, enrichment, food, litter, home modifications), long-term outcomes (e.g., likelihood of continuing indoor-only lifestyle, ease of transition, future intentions) and open-ended questions capturing main benefits, challenges, and advice for others.

2.3. Participants and recruitment

During recruitment for the related Railton et al. (2025) study, potential participants were screened based on their cats' current indoor/outdoor status, with those that had already transitioned their cat indoors, ineligible for the prospective transition study (Railton et al., 2025). However, the research team felt it was important to capture these people's previous experiences, and thus a survey was created to do so. Ineligible participants for the prospective Railton et al. (2025) study were given the opportunity to complete the survey, and additional participants were recruited through the CANZ December 2024 newsletter and CANZ' and Healthy Pets' email networks. Inclusion criteria required participants to be over 18 years of age, to have experienced transitioning at least one cat from outdoor to indoor-only living at any time in the past, and to currently manage their cat as exclusively indoors, or with access to enclosed outdoor areas (e.g., catio), or walked outdoors on a leash. Participants were asked to complete the survey by reflecting on one selected cat's transition to indoor living. While participants could fill out the survey multiple times for additional cats, only their first response was included in the analysis.

2.4. Data management

Only participants who gave informed consent, completed the survey and provided a response regarding their cat's current outdoor access were included in analysis. Responses were checked for duplicate entries and for any inconsistent or unrealistic answers; where identified, the response was removed from the data set. Ten participants reported that, while they had begun, or completed the process of moving their cat indoors, since the transition, unsupervised outdoor access had been reinstated. These participants were retained within descriptive and qualitative analyses because it was determined that 1. their experiences of the transition process remained relevant to the study aims, and 2. for these participants, the transition indoors may have been ongoing. Fifty-six respondents did not provide a response when asked about their cat's current outdoor access and were excluded from data analysis. As one of the study's aims was to explore how owners' experiences of the transition process related to their cat's current management status (which included whether cats had been given outdoor access again following a difficult transition), it was not possible to meaningfully include these

respondents without this information.

Thirteen respondents did not provide an age for when their cat was transitioned indoors, possibly due to ambiguity in the wording of the questions, and were excluded from analysis of this variable.

2.5. Data Analysis

Descriptive analysis was completed in Excel (V16; Microsoft, Redmond, WA, USA) and SPSS (V29.0.1.0; IBM, Armonk, NY, USA). Fisher's exact tests were used to examine two associations between how the cat had adjusted to moving indoors. Adjustment was dichotomised as 'adjusted within days' versus 'took longer to adjust'. The first test examined the association between adjustment and cat age at transition, comparing cats transitioned before 2 years of age with those transitioned at over 2 years of age. The second test examined the association between adjustment and owner-rated happiness after moving indoors; happiness ratings were dichotomised as happy (very happy + happy) and unhappy (neither happy nor unhappy + very unhappy + unhappy). Statistical significance was set at $p < 0.05$. As only two tests were conducted and the study was exploratory in nature, no correction for multiple comparisons was applied; results should be interpreted with this in mind. Sensitivity analyses were conducted to assess the influence of the 10 cats with continued outdoor access on inferential results. Fisher's exact tests were run twice for comparison, first with the 10 participants included, and then without. As the inclusion of these participants appeared to inflate certain associations, these participants were excluded from inferential analyses on the basis of still having outdoor access. However, these participants were retained in descriptive and qualitative analyses of the transition process, given their experiences of transitioning were still relevant.

For multiple-response questions, where respondents selected 'Other' and provided an explanation, responses were reassigned to existing categories where applicable. Responses relating to perceived benefits and challenges of bringing cats indoors were organised into themes and subthemes using a general inductive approach (Thomas, 2006). Where respondent meaning remained ambiguous, entries were provisionally assigned to the most plausible theme and reviewed by the authors. Representative quotes were extracted and reported and edited only where necessary for clarity, while maintaining the original meaning.

3. Results

3.1. Demographics

A total of 151 responses were collected, of which 87 met inclusion criteria and were included in analysis. Respondents had a wide range of ages and were mainly female (Table 1). Cat age was most commonly reported as nine or more years of age (40.2%) and just over half (56.3%) of cats were living in single cat households. All cats were desexed, with 57.5% female and 42.5% male.

3.2. Outdoor history of participant's cats

Although the survey targeted owners who had transitioned their cats indoors, only 40.2% of the cats never went outside at the time of the survey; the remainder had varying levels of outdoor access (Table 2). Ten cats were reported to have unsupervised outdoor access. As noted above, these cats were retained within data and analysis because it was possible they were still in the process of transitioning, and their owners experiences remained relevant to the aims of the study. Approximately half the cats had been kept indoors less than two years. Most cats (57.5%) were reported to have been moved indoors when they were more than two years of age.

Table 1
Demographics of cat owners and their cats collected within a survey of NZ residents documenting past experience with transitioning a cat indoors. Survey was available online between December 2nd and 8th 2024.

Demographic[a]	N (%)
Owner age (n = 79)	
18–24	3 (3.8)
25–34	11 (13.9)
35–44	14 (17.7)
45–54	16 (20.3)
55–64	16 (20.3)
65–74	20 (25.3)
75 or older	8 (10.1)
Owner gender (n = 78)	
Female	68 (87.2)
Male	6 (7.7)
Non-Binary	3 (3.8)
Prefer not to say	1 (1.3)
Cat age (n = 87)	
1–2 years	10 (11.5)
3–4 years	19 (21.8)
5–6 years	12 (13.8)
7–8 years	11 (12.6)
9 years or more	35 (40.2)
No. of cats in house (n = 87)	
1	49 (56.3)
2	25 (28.7)
3 or more	13 (14.9)
Cat Sex[b](n = 87)	
Female	50 (57.5)
Male	37 (42.5)

[a] Participants were required to answer all questions on cat demographics, however answers for owner demographics were voluntary.
[b] All cats were desexed.

Table 2
Outdoor access of cats included in an online survey study of NZ residents, collected between December 2nd and 8th, 2024.

Demographic	N (%)
Current outdoor access (n = 87)	
Goes outside and moves around freely outside my supervision	10 (11.5)
Goes outside and moves around freely within my supervision	8 (9.2)
Goes outside in enclosed area (e.g., catio)	24 (27.6)
Never goes outside	35 (40.2)
Goes outside on harness	7 (8.0)
Other	3 (3.4)
How long have they been kept indoors? (n = 87)	
Less than 1 year	22 (25.3)
1–2 years	22 (25.3)
> 2 years	43 (49.4)
Age when moved indoors (n = 74)	
< 6 months	9 (9.5)
6–12 months	4 (4.6)
1–2 years	11 (12.6)
> 2 years	50 (57.5)

3.3. Resources used in indoor transitioning

The most common resource used by owners during a transition to keeping their cat indoors was online research or websites (34.5%) followed by veterinary advice (26.4%) (Table 3). Most owners had not prepared for the transition (46.0%) or the transition had been unplanned (35.6%), with only 9.2% of respondents preparing for weeks prior to the transition. The most common resources added to the house were scratching posts (64.4%) and more litter boxes (50.6%). Scratching posts, hiding places and cat beds were the most common resources already available to the cats (85.1%, 79.3% and 77.0%, respectively).

Table 3
Owner reported resources used and made available to their cat during a transition indoors as collected through an online survey open to NZ residents between December 2nd and 8th, 2024, n = 87.

Resource	N (%)*
Sources of information	
Online research/website	30 (34.5)
Veterinary advice	23 (26.4)
Books about cat behaviour	9 (10.3)
Social media	8 (9.2)
Friends/family	9 (10.3)
Cat shelter/organisation advice	9 (10.3)
Online videos	4 (4.6)
Other	11 (12.1)
Animal behaviourist/trainer	1 (1.1)
None of the above	31 (35.6)
Preparation time prior to transition	
No preparation	40 (46.0)
Days	4 (4.6)
Weeks	8 (9.2)
Unplanned**	31 (35.6)
Resources added or modified in the house	
Scratching post	56 (64.4)
More litter boxes	44 (50.6)
Vertical furniture	35 (40.2)
Changed doors and/or windows to prevent escape	32 (36.8)
Built outdoor enclosure	18 (20.7)
Moved furniture	6 (6.9)
Other	17 (18.7)
No changes	13 (14.9)
Resources available for the cat	
Scratching posts/furniture	74 (85.1)
Hiding places	69 (79.3)
Cat bed	67 (77.0)
Food treats	64 (73.6)
Wand toy	57 (65.5)
Vertical furniture	52 (59.8)
Indoor cat grass or cat specific plant	28 (32.2)
Motorised toys	25 (28.7)
Motorised water fountain	23 (26.4)
Pheromones	22 (25.3)
Enclosed outdoor area (e.g., catio)	20 (23.0)
Food puzzle	19 (21.8)
Outdoor enclosure	18 (20.7)
Auto-feeder	9 (10.3)
Self-cleaning litter tray	6 (6.9)

** Unplanned encompassed cats who were initially moved indoors due to necessity (e.g., medical need, immediate concern for safety, moving house etc.).
* Owners could select multiple responses. % indicated is calculated based on n = 87 for each response.

Table 4
Owner reported motivations for, and experiences of, transitioning a cat indoors as collected through an online survey of NZ residents between December 2nd and 8th, 2024 (responses n = 87).

Motivations and experiences	N (%)
Main reason to move cat indoors[a]	
Safety concerns (e.g. traffic, other animals)	67 (77.0)
Local wildlife protection	30 (34.5)
Moving to a new home	30 (34.5)
Health issues/requirements	22 (25.3)
Cost of outdoor-related vet care	15 (17.2)
Previous injury/accident	10 (11.5)
My veterinarian advised me	6 (6.9)
Age-related concerns	5 (5.7)
Neighbour conflict	4 (4.6)
Moved to retirement village	3 (3.4)
Other	13 (14.3)
Length of time to adjust	
Adjusted right away	35 (40.2)
Days	7 (8.0)
Weeks	15 (17.2)
Months	14 (16.1)
Still haven't adjusted	11 (12.6)
Other	4 (4.6)
Likelihood of keeping cat indoors	
Very unlikely	3 (3.4)
Unlikely	3 (3.4)
Neither likely nor unlikely	5 (5.7)
Likely	4 (4.6)
Very likely	67 (77.0)
Moving my cat indoors was easier than I thought	
Strongly disagree	8 (9.2)
Disagree	3 (3.4)
Neither agree nor disagree	11 (12.6)
Agree	17 (19.5)
Strongly agree	43 (49.4)
Intention for keeping future cat indoors	
Yes	66 (75.9)
No	6 (6.9)
Undecided	10 (11.5)
Perceived happiness of cat	
Very unhappy	9 (10.3)
Unhappy	5 (5.7)
Neither happy nor unhappy	2 (2.3)
Happy	27 (31.0)
Very happy	39 (44.8)

[a] Owners could select multiple responses. % indicated is calculated based on n = 87 for each response.

3.4. Owner motivations for, and experiences of, transitioning their cat indoors

The main motivation for people to move their cat indoors was safety concerns (77.0%), followed by protecting wildlife and due to moving to a new home (34.5% each; Table 4). Approximately 40% of cats adjusted right away, while 11 cats (12.6%) were reported to still not have adjusted to living indoors at the time of the survey (Table 4). Of these 11 cats, eight had been indoors less than a year, one for 1–2 years and two cats had been indoors for more than two years, seven currently had unsupervised outdoor access at the time of the survey and seven were over five years of age. Behavioural signs of poor adjustment reported by these owners included scratching, aggression, vocalisation and in one case, stress-related alopecia requiring veterinary intervention. Two of these owners indicated the transition was only intended to be temporary due to health concerns.

Approximately three-quarters of respondents indicated they were very likely to continue keeping their cat indoors (77%) and would keep any future cats indoors (75.9%), and 68.9% agreed or strongly agreed it was easier to keep their cat indoors than they had thought it would be. Of the six respondents who rated the likelihood of keeping their cat indoors in the future as unlikely or very unlikely, five were from eleven owners who had reported their cat had still not adjusted to being indoors. Cats were reported to be happy or very happy indoors by 75.8% of respondents.

Of cats that had adjusted at the time of the survey, cats transitioned before 2 years of age were more likely to adjust within days compared to those transitioned at over two years of age (75.0% or 18/24 vs 39.6% or 19/48, respectively; Fisher's exact p = 0.006). Cats that had adjusted within days were associated with being rated as more happy by their owners (94.1% or 32/34 vs 73.5% or 25/34, respectively; Fisher's exact p = 0.045). Of the 11 cats that were reported not to have adjusted yet, eight were rated as very unhappy and two were rated as unhappy, with one respondent not answering the question.

Reported challenges included implementing the practical changes necessary for keeping a cat indoors, providing adequate enrichment, perceived changes in cat behaviour, impacts on cat health, effects on owner emotions, sleep and lifestyle, judgement from others, increased spending on enrichment and maintenance, and difficulty dealing with other roaming cats (Table 5).

3.5. Perceived benefits of keeping a cat indoors

Participants reported that the transition had been beneficial for their

Table 5
Challenges to bringing cat indoors as reported by participants of a survey of NZ residents, available online between December 2nd and 8th, 2024. Participants could provide multiple responses (total responses = 174).

Theme	Subtheme	Representative Quotes
Practical challenges	Doorway management	*"Training guests…to look out for cats and shut external doors"*
		"Making sure she doesn't escape when we are going out a door"
		"Making sure everyone is careful not to leave doors or windows open for our cats to escape."
		"Keeping the doors closed constantly without forgetting. Reminding visiting family and friends to do the same."
	Preventing escape	*"ensuring there are no ways to get out"*
		"Being watchful she doesn't escape."
		"Building an enclosure he couldn't escape from"
	Litter box maintenance	*"Having to scoop poop daily"*
		"Litter box needs full change more often (pee)"
		"Cleaning litter tray daily (with pellets) is a pain."
		"more litter tray supplies and cleaning required"
	House cleanliness	*"More cat hair everywhere (he's very hairy)"*
		"Rat and mouse and rabbit invasion and damage"
		"Hygiene when she refuses to use her litter box."
	Space	*"Trying to have lots of litter boxes available but we only have a smallish house; space for litter boxes, cat furniture etc."*
		"Creating space solely for the cats that still makes it usable for people"
	Pet-sitting	*"finding sitters I feel confident won't let her out and will give her enrichment when we go away"*
Judgment from others		*"Some backlash from people who insisted it was "cruel""*
		"Opinions of some people, need education"
		"Other people complaining, saying cats belong outside"
Impacts on owner	Stress	*"Worry that she is not entirely happy being confined inside."*
		"Worried about their mental health"
		"Worrying about the constant risk of the cat escaping"
		"Worried about giving enough enrichment"
	Feelings of guilt	*"Feeling bad for restricting her life when she had previously been such an adventurer outdoors."*
		"The cats wanting out for the first week and feeling bad"
		"My own worry about them missing being outside"
	Sleep	*"Disturbed sleep because cat wasn't happy"*
	Owner lifestyle changes	*"Not being able to open windows whenever we want"*
		"Not able to leave the house too long or she becomes anxious"
		"Can't open most doors/windows when it's hot"
		"Extra time needed for enrichment and attention"
		"I have to leash walk him daily at a sort of set time so cannot be away from home in the evening"
Cat behaviour	Behaviour changes	*"Ripping carpets & curtains"*
		"Scratching doors at night to get outside"
		"She alternatively hid or frantically tried to escape!"
		"misbehaving when he can't go out"
	Toileting issues	*"He won't use a litter box"*
		"Adjusting to toileting indoors"
		"Peeing on furniture" note: inappropriate elimination can be a sign of mental or physical health issues in cats*
Cat health	Physical health	*"They got fat and had to go on a diet"*
		"Keeping cat active"
		"Her curiosity meant she fell out a window"
	Mental health	*"Cat very stressed"*
		"The cat seems sad"
		"Excessive grooming"
		"Cat struggled with boredom"
Other outdoor cats		*"Cat gets grumpy at cats outside in the yard, but they ignore him because they know he can't get to them. Mostly seems to be a minor annoyance for him though - no fluffing or major stress or hissing."*
		"Keeping away all of the neighbour's cats that keep coming onto our property and upsetting my cats"
Enrichment	Environmental	*"Providing some safe outdoor space (via a catio)"*
		"Having enough hides and vertical space in the house so 3 cats can get on in relative harmony"
		"Needed to be more intentional about enrichment including creating plenty of places for her to sleep and explore."
		"Providing enough enrichment and exercise"
		"doesn't have space to run around"
	Interactive	*"Ensuring he has enough exercise and stimulation"*
		"Need to entertain cats more yourself"
		"have to make time to play with cat"
		"I have to make the time to go outside with her everyday"
		"Finding appropriate enrichment activities"
Financial	Increased costs	*"increased costs of buying litter and enrichment toys, etc."*
		"costs of building enclosure"

cat's health and safety, reduced veterinary costs, improved household dynamics, ameliorated anxieties over their cat's safety and reduced their cat's impact on native wildlife (Table 6).

3.6. Cat behavioural changes reported following indoor transition

The most commonly reported cat behavioural change following transition was increased attention-seeking (n = 43), followed by increased vocalisation and sleeping (n = 31 each). Respondents also reported that play (n = 25) and scratching (n = 20) increased, while aggression, eating, and grooming were largely unchanged for the majority of owners (Fig. 1).

3.7. Cat happiness and length of time indoors

When cats had been kept indoors for under a year, only 42.1% were rated as happy or very happy, however, 90.9% of cats who had been kept indoors for 1–2 years, and 92.7% of cats kept indoors for over two years were rated as happy or very happy.

3.8. Cat vocalisation frequency and adjustment time

Nearly a third (32%, or 10/31) of owners of cats who showed increased vocalisation following transition reported their cat as not having adjusted, while none of the owners reported this when their cats vocalisation had not changed. Over half of cats with no change in vocalisations (51%, or 26/51) were reported to have adjusted immediately, compared with 23% (7/31) of cats whose vocalisation increased.

Table 6
Benefits of bringing cat indoors as reported by participants of a survey of NZ residents, available online between December 2nd and 8th, 2024. Participants could provide multiple responses (total responses = 190).

Theme	Subtheme	Representative Quotes
Cat safety	General safety/ knowledge of whereabouts	*"I know they are safe while I am away from home"* *"safety – I know my cat will be alive longer"* *"Reassurance that my cats are safe, especially in storms or with fireworks"* *"easy to find them to transport to vet or other home"*
	Injury	*"As an older cat, she has less risk of injury"* *"Less Injuries"*
	Traffic/ Road safety	*"no more injuries (my cat has been hit by a car in the past)"* *"No worry about traffic"* *"Keeps them safe from traffic and other man-made hazards"*
	Cat fights	*"She doesn't get into cat fights with strays"* *"No cat fight wounds"* *"No risk from other neighbourhood (dominant) cats"*
	Animal attacks	*"less likely to get hurt. We have had dog attacks on cats in my area"* *"Keeps them safe from other animals that may harm them"* *"Cat's safety from…poisonous animal bites (when we lived in Australia)"*
	Going missing/ Being stolen	*"My cat will never go missing"* *"No chance of getting stolen / lost"* *"No disappearing"*
	Human harm	*"keeps them safe from humans that may harm them"* *"No worry about people hurting them"* *"Safe from kill traps in bush"*
	Threats from neighbours	*"Not getting shot by neighbour"* *"She does not bug any neighbours (who don't like cats)"* *"No threats of harm from neighbours"* *"No worry about them getting hurt through… interactions [with] anti-cat neighbors who trap or bait"*
Cat health	Improved health	*"Reduced incidence of squamous cell carcinoma"* *"approaching normal weight"* *"fewer health issues"* *"No need to worry about getting any ticks/ flea bites"*
	Ability to monitor health	*"Able to monitor my cat's health, especially toileting much easier (i.e. looking for signs cystitis is flaring up again)"* *"can monitor food intake better"* *"I can keep an eye on her litter box because she has stomach issues"*
Veterinary costs	Reduced spending	*"Immunisation/Flea treatment required less frequently."* *"No more surprise $1000 vet bills after cat fight"* *"a lot less vet bills and medical costs"*
Household dynamics	Increased sociability	*"More sociable cats"* *"Increased friendliness of cat"* *"[the] cats are more affectionate and cuddly"* *"I have siblings who play with each other a lot more."*
	Improved human-cat bond	*"Our bond has increased - I work from home so am able to give her a lot of attention"* *"better bonding with us"* *"Sleeps closer to me"*
Owner wellbeing	Reduced owner anxiety	*"Less anxiety about fights, injuries, disappearing etc."* *"Less anxiety over where she is and what she is up to"* *"less worry for me as I know where he is and is safe"*
	Improved relationship with neighbours	*"Better relationships with neighbours"* *"Not concerned about neighbour complaints"*
Wildlife Protection		*"Reduces risk to local birds"* *"Wildlife is safe from her"* *"I know that the cat does not hunt."* *"Better outcomes for wildlife"*

3.9. Financial impacts of indoor transitioning

Owners associated the transition with increased spending across most categories, specifically litter (n = 54) and enrichment (n = 42). Cat furniture and cleaning costs also increased for a proportion of owners (n = 38 and n = 25, respectively). Veterinary costs were an exception, with 30 owners reporting spending less following transition (Fig. 2).

4. Discussion

This study aimed to gather insights into the experiences and perceptions of owners transitioning their cats indoors. Most participants reported it was easier to move their cat indoors than expected, and indicated it was very likely they would continue to keep their cat indoors. However, a small number of owners reported their cats had still not adjusted to being indoors and rated their cats as being unhappy. Cat safety was the main reason given by participants for moving cats indoors. Owners reported encountering several practical challenges (e.g., doorway management and maintaining litter boxes) and described multiple benefits (e.g., health and safety, and reduced veterinary costs) related to keeping cats indoors. These owner reports provide useful data to inform future strategies aimed at advising and supporting owners who are considering moving their cat indoors.

4.1. Owner motivations for transitioning cats indoors

Over three quarters of owners cited cat safety as a motivation for choosing to transition cats indoors; health-related factors were at the forefront of this, including individual health requirements and previous outdoor-related injury or accident. This is in keeping with previous literature, in which cat health and safety were most commonly reported by owners as motivating factors for moving cats indoors (Foreman-Worsley et al., 2021; Ovenden et al., 2024; Kaine et al., 2024; Railton et al., 2025). Awareness of cat health and safety risks plays a role in prompting people to consider keeping cats indoors. Perceived risk of outdoor hazards such as predation, fights with roaming cats, and transmission of zoonotic diseases has previously been associated with likelihood of having an indoor-only cat, with owners who perceive the risks to be high more likely to have keep their cat indoors and owners who perceive the risks to be low more likely to have an outdoor cat (Gramza et al., 2016).

The impact of free-ranging cats on native wildlife is frequently invoked in appeals to restrict cat roaming; however, previous literature suggests that environmental messaging often fails to motivate owners to change their behaviour and, in some cases, may have counterproductive consequences (Kaine et al., 2024). Therefore, it is noteworthy that over a third of participants in the current study cited environmental concerns as a motivating factor, though motivations may differ depending on an individual's awareness of cat environmental impacts (Gramza et al., 2016), and the region in which they reside (Bassett et al., 2020). Environmental messaging may be particularly persuasive in places with high biodiversity, like Australia and New Zealand, where the safety of native wildlife is a prominent public concern (Toukhsati et al., 2012; Hall et al., 2016); understanding these regionally specific differences is important for developing effective cat management messaging and owner

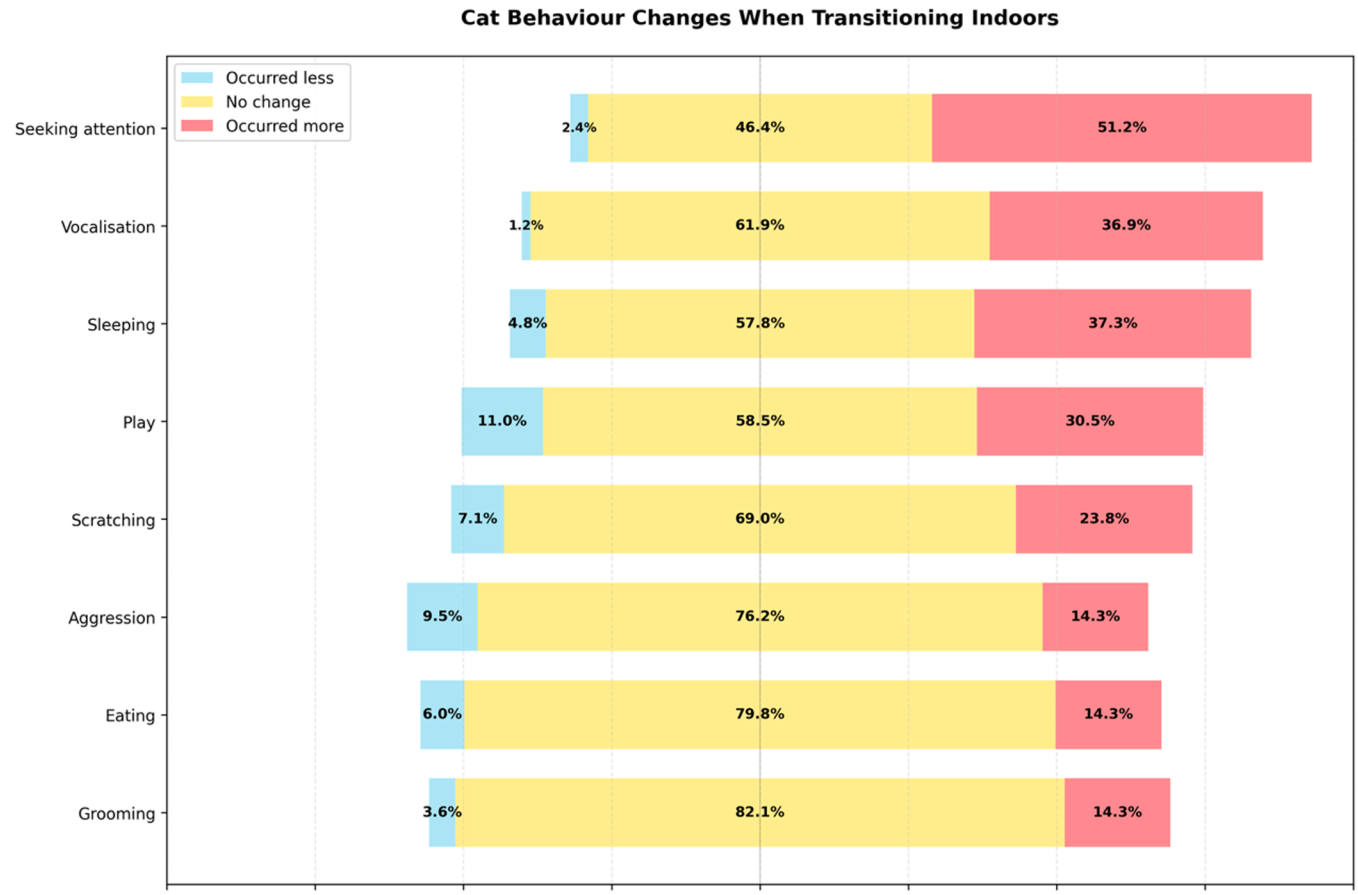


Fig. 1. Owner reported cat behaviour changes when transitioning a cat indoors as collected through an online survey of NZ residents between December 2nd and 8th, 2024 (n = 84 for seeking attention, vocalisation, scratching, aggression, eating, grooming; n = 83 for sleeping, n = 82 for play).

resources.

4.2. Owner experiences of indoor transitioning

Over two thirds of participants reported the indoor transition to be easier than anticipated, most indicated that it was likely they would keep their current cat indoors, and over 70% indicated that they would be likely to keep a future cat indoors. These findings are in contrast with the findings of Railton et al. (2025), in which 60% of participants reported the transition indoors to be "somewhat difficult" and only 20% intended to continue indoor management after the study period. However, these differences are likely due to study design and data collection methods. Railton et al. (2025) recruited 16 participants prospectively into an assisted transition programme, meaning their sample may have captured owners who were less certain about the process and had sought out support. Additionally, as the study was conducted over the summer, owners may have been less motivated to keep their cats indoors given the logistical challenges of keeping windows and doors closed in warmer weather. In contrast, the present study surveyed owners retrospectively who had already attempted (largely successfully) to transition their cat, introducing an inherent survivorship bias (Elston, 2021). Those who found the transition too difficult or abandoned it entirely are unlikely to have self-selected, thus potentially explaining our participants largely positive assessment of the transition process.

4.3. Challenges

While most participants found the transition easier than expected, challenges remained. Door management, increased litter maintenance and general cleaning requirements were commonly reported. The former is consistent with Railton et al. (2025), where owners, especially those with children, struggled to ensure doors were kept closed. Previous studies have linked households with children and dogs to a higher likelihood of cats' having outdoor access (Chung et al., 2024). The present study suggests that the added complexity of preventing escape in these households may partly explain this association. Litter maintenance and eliminations outside the litter tray are a well-documented source of owner frustration, prompting extensive research into resolving toileting issues (Heath, 2019; Kasbaoui et al., 2022), enticing cats to use litter trays (Cottam and Dodman, 2007; Guy, et al., 2014; Ellis et al., 2017; Frayne et al., 2019) and driving innovations such as automated litter robots (Wang, 2021; Ikeda and Nakasho, 2025). Owner preference for cat outdoor toileting has previously been cited as a reason for allowing outdoor access, highlighting that litter management remains a practical barrier to sustained indoor management (Foreman-Worsley et al., 2021).

Participants also reported impacts on their own comfort and lifestyle, including discomfort from keeping windows closed, and struggling with the effort and time required for cleaning and providing interactive enrichment. Similar challenges were reported by Railton et al. (2025). Within the present study, some participants made considerable lifestyle alterations, such as restricting time away from home to ensure they were back for their cat's daily walk or to minimise their cat becoming anxious. Participants also reported experiencing feelings of stress or guilt about the impacts of their choice to keep their cat indoors. These findings are in keeping with previous research linking indoor-only housing with pet-related feelings of guilt (Kogan et al., 2024). Pet-related guilt, similar to parental guilt, can be a significant predictor of owner depression and anxiety (Kogan et al., 2023), highlighting how management decisions affect not only the cat's welfare but may also

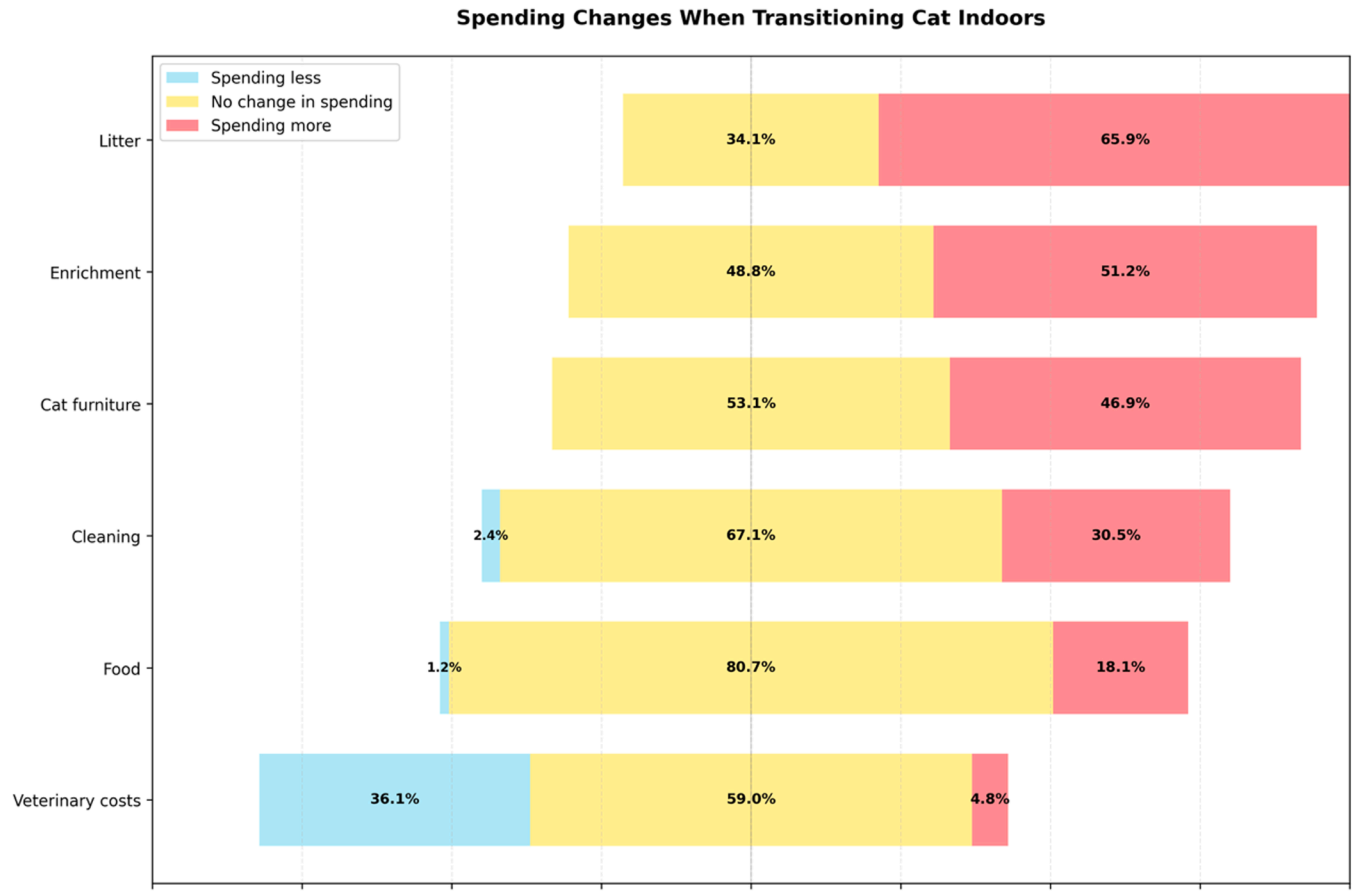


Fig. 2. Owner reported financial changes when transitioning a cat indoors as collected through an online survey of NZ residents between December 2nd and 8th, 2024. (n = 82 for litter, enrichment, and cleaning; n = 81 for cat furniture; n = 83 for food and veterinary costs).

influence owner wellbeing. Interventions aimed at supporting indoor-only management decisions should therefore consider the potential impacts on human wellbeing and incorporate strategies that help owners to feel confident and supported during the transition.

Cat-related challenges included increases in behaviours that participants found disruptive, such as scratching at doors, frequent vocalisation and urinating outside of the litter tray. These behaviours may signal frustration or stress in cats adjusting to management/care changes, though urination outside of the litter tray may also indicate cat dissatisfaction with litter tray set up (i.e., sharing trays with other cats, tray size, litter type, frequency of cleaning, location etc.) or an underlying health issue (Heath, 2019). While safety and health benefits were primary motivators for transition, health concerns were also mentioned as challenges. For example, participants mentioned concerns about cat weight gain, and the potential for cats to sustain an injury during escape attempts. Concern for cat mental health was prominent in owner reports, with cats described as appearing 'bored' or 'sad', and some exhibiting behaviours potentially related to stress, including toileting issues and overgrooming. These challenges align with a recent review by Calver et al. (2026), which acknowledges that containment may contribute to cat weight gain, diabetes, and behavioural problems, and that solutions including environmental enrichment, exercise, and correct feeding may place demands on owner time and finances. Importantly, these authors highlight that the advantages of containment for cat health and welfare are considerable and suggest the disadvantages are often able to be avoided or rectified (Calver et al., 2026). Finally, some participants noted an increase in roaming cats visiting their property following transition, which they perceived caused stress for their now-indoor cat.

4.4. Benefits

The benefits owners reported following transition broadly reflected their original motivations, particularly around safety and cat health. Reduced anxiety about their cat's whereabouts and safety was a prominent theme, encompassing concerns about traffic, fights with other cats and risk of intentional harm. These benefits are in keeping with owner reports in previous literature (Ovenden et al., 2024; Kaine et al., 2024; Foreman-Worsley et al., 2021). Participants within the present study also cited improved ability to monitor their cat's health, and a perceived reduction in veterinary costs as benefits from keeping their cat indoors. Some participants reported relief at no longer needing to worry about fleas or ticks. However, preventative health care, such as check-ups, vaccinations and flea and worming remains necessary for indoor cats (Marcinkiewicz, Watson, 2024) suggesting a need for better owner education around the on-going health care needs of indoor cats, especially if cats are still receiving supervised outdoor access. For some participants, the move indoors was perceived to increase their cat's sociability and improve the human-cat bond, with owners reporting a perceptible increase in their cat's displays of affection and interest in interacting. Previous studies have found associations between indoor husbandry and more positive cat-owner relationships (Henning et al., 2023; de Abreu Oliveira et al., 2023). However, it is important to note that indoor housing is also likely to increase human-cat proximity and interactions, and this in and of itself may also increase the perceived bond quality, as observed in Riggio et al. (2022), where confinement during the COVID−19 pandemic had a positive effect on owner perceptions of their relationship with their cat.

Improvements in neighbour relations were reported after moving cats indoors. Vexations from neighbours over outdoor cats have been

highlighted within the literature, with disputes often stemming from a general disdain for cats, concerns about the cat's impacts on native wildlife, or issues with the cat trespassing onto a neighbour's land and damaging property, attacking animals (such as chickens) or causing anxiety for the neighbour's indoor cat (Hill, 2024a). For several participants in the present study, concern about neighbour's reactions extended to fears of poisoning and deliberate harm to their cat. In some cases, this had been the main motivation for moving their cat indoors. Similar concerns around the risk to cats from neighbours and strangers have been documented within the literature (Foreman-Worsley et al., 2021; Hill, 2024b). These fears are unfortunately well-founded, with cats, especially those that are free roaming, a target for theft (Allen and Wyatt, 2024, Stickle et al., 2025) and a common victim of animal cruelty (Gwaltney-Brant, 2016; Aradilla et al., 2025; Caldwell et al., 2025; Calver et al., 2026).

4.5. Owner perceptions of cat adjustment to indoor housing

While approximately half of the participants within this study perceived their cat had adjusted within weeks, eleven participants (12.6%) reported that their cat had still not adjusted to the indoor transition at the time of the survey. However, nine of these participants were still allowing, or had reintroduced, unsupervised outdoor access. Reintroduction of outdoor access during the transition period may have complicated and prolonged the adjustment process. Within applied behaviour analysis, the increased intensity of behaviours such as vocalising or door scratching that commonly accompany removal of a reinforcer (outdoor access) is referred to as an 'extinction burst', and is generally temporary if the reinforcer is consistently withheld (Malamed and Sueda, 2022). However, intermittent reintroduction (for example if an owner feels guilty about their cat's perceived distress) can inadvertently maintain the unwanted behaviour by teaching the cat that persistence will eventually be rewarded (Malamed and Sueda, 2022). Further study is necessary to determine if this may have been the case with the cats that did not adjust, and the characteristics and management of cats that may be more difficult to transition indoors.

Owner-perceived cat happiness was considerably higher in cats that had been indoors for over a year compared to those indoors for less than a year. This may indicate that cat happiness increases over time, as cats adapt to being kept indoors, or that owners perceive their cats as happier the longer they have been indoors. It may also reflect a bias in which cats who do not adjust to indoor living are less likely to remain indoors long-term and may therefore be underrepresented in the longer-duration groups.

For many behaviours, no change was noticed by participants. However, behaviours related to social interaction were most likely to be reported as having increased, including those perceived negatively (e.g., vocalising) and those perceived positively (e.g., play). Play behaviour is generally considered an indicator of positive welfare in animals, including cats (Henning et al., 2023), and has previously been shown to increase when cats are moved indoors (Henning et al., 2025a). Play may therefore be a behavioural useful indicator of a cat's welfare during indoor transitioning, however it may also be a reflection of cats seeking opportunities for stimulation or a redirection of energy, now that they are confined indoors. This would be a valuable direction for future studies to investigate. Conversely, increased vocalisation can be an behavioural indicator of frustration or stress in cats (Amat et al., 2016). Increased vocalisation following transition was more often reported by owners whose cats took longer to adjust, or had still not adjusted at the time of the survey, suggesting that increased vocalisation may be a behavioural marker of a more challenging adjustment process, or at least may be perceived as such by owners. However, these results should be interpreted with caution. Cats vocalise for many reasons and while increased vocalisation following indoor transition was perceived negatively by participants, it does not necessarily indicate poor welfare. For instance, human-directed vocalisations are often affiliative, occurring during greeting, attention-seeking or in anticipation of routine events (such as feeding or being let outdoors) (Tavernier et al., 2020, Brown, 2023). Cats kept indoors are exposed to more frequent opportunities for human-cat interaction which may both increase the likelihood of vocalisation and the human observation of it. Further, some cats may vocalise more during transitional periods as they adapt to new routines. As noted earlier, if an owner allows outdoor access in response to a behaviour such as vocalisation, that behaviour is more likely to continue (Malamed and Sueda, 2022). The overlap between non-adjustment and increased vocalisation may reflect a cycle in which cats who struggle with transition prompt owners to reestablish outdoor access, inadvertently reinforcing the behaviour. Larger studies with objective measures of vocalisation are needed to explore this further.

Importantly, changes in behaviours associated with welfare concerns, such as aggression, eating and grooming were rarely reported to have changed. However, owner-reported behavioural assessments should be interpreted cautiously, as owners are prone to view behaviours through their own biases (Powell et al., 2023). Previous studies show humans struggle to recognise cat behavioural cues (Henning et al., 2025b), are more likely to focus on 'problem' behaviours that impact their lifestyle (Powell et al., 2023) and, are prone to projecting anthropomorphic perceptions when interpreting cat behaviour (Bouma et al., 2024).

4.6. Environmental modifications and financial impacts of transitioning indoors

Most participants made at least one modification to support their cat's transition indoors, ranging from the addition of scratch posts to construction of outdoor enclosures. Financially, transition was associated with a general increase in costs across most categories, with the exception of veterinary bills. Further, several participants specifically cited the costs of maintenance and enrichment as challenging, highlighting an important equity consideration; indoor only husbandry may be harder to achieve for those with limited incomes (Cotterell et al., 2025). Policies intended to restrict cat roaming or increase uptake of indoor transitioning will need to account for socioeconomic disparity. Without adequate provision, low income or low socio-economic status owners may be unable to meet their cats welfare needs indoors, leading to cats living in sub-optimal conditions or resulting in increased relinquishments of cats and exacerbating existing pressures on shelters (Card et al., 2018; McDowall et al., 2023).

4.7. Preparation and information sourcing prior to indoor transition

Over a third of participants (36.5%) reported having to make an unplanned transition due to unexpected circumstances such as cat medical issues, changes in their housing situation or sudden safety concerns. A further 46% made a planned transition but with no preparation. This large percentage of unplanned transitions highlights that transitioning a cat to indoor only housing may be necessary for numerous reasons and is not solely an issue of owner choice; this illuminates an under-discussed area within the indoor/outdoor management debate and literature, and a potential gap in current initiatives and resources aimed at supporting indoor transitions. Future work should develop indoor housing programmes and resources with a diverse audience and range of contexts in mind, including owners who may find themselves needing to keep a cat indoors urgently.

Despite the majority of participants either not preparing (46%), or having no time to prepare (36.5%) for an indoor transition, over two-thirds still reported that the transition was easier than expected. This may suggest that cats were capable of adapting relatively easily, participant homes were already well set up, or that adjustments were being made to meet needs as they arose. Online resources were the most commonly consulted source of information reported by owners. Self-guided searches of online resources has become an increasingly

common practice for people in numerous contexts including when seeking veterinary and other pet-related knowledge, with owners often turning first to online sources of information before consulting their vet (Kogan et al., 2009; 2018). While veterinarians continue to be rated as the highest quality source of information (Kogan et al., 2009, 2018), these findings reinforce the importance of ensuring accurate information is easily accessible online, and the value of veterinarians steering clients towards credible sources (Boden, 2018). The rapid rise of large language models as a primary means of online information seeking (Bean et al., 2025) may add further complexity to this picture and should be explored in future studies.

4.8. Limitations

Several limitations should be considered when interpreting these findings. The relatively small sample size limits generalisability, and the retrospective design introduces the potential for recall bias that may affect accuracy of participant reports. Furthermore, some inconsistencies were noted between responses, such as conflicting answers regarding current levels of outdoor access, suggesting some participants may have misunderstood questions. The background of participating cats (e.g., breeder or shelter origin) was not recorded. Prior environmental experience may have influenced the indoor adjustment outcomes. Unexpected participant responses to some questions suggest that the wording of some questions were ambiguous. For example, questions regarding changes in aggression following the transition did not specify whether aggression was directed toward conspecifics or humans, limiting the interpretability of these responses. Similarly, the question regarding increases or decreases in play behaviour did not differentiate between cat-initiated play, owner-initiated interaction, play with conspecifics, or engagement with play objects, limiting interpretation of reported increases. While information was collected regarding environmental modifications made in households, no analysis was conducted examining whether such modifications adequately accommodated the social and spatial needs of multiple cats and influenced conspecific interactions. Additionally, scratching of furniture was measured as a discrete behaviour but scratching post use was not, meaning it is unclear whether increases reflected a general rise in scratching behaviour or a lack of appropriate outlets. Future studies should ensure aggression questions clearly distinguish the target of aggressive behaviours, and should examine the relationship between environmental modifications, scratching behaviour, and cat-cat interactions in multi-cat households. Future studies would also benefit from drafting clearly worded questions with explicit instructions (where needed) for the desired format of the answer, formal or operative definitions of potentially subjective terms, and pilot testing for ambiguity. For instance, concepts such as ‘happiness’ are inherently subjective and introduce variability in how individual participants may respond to questions. This is a recognised and widely documented challenge in companion animal welfare research more broadly (Serpell, 2019). Within this study, the term 'happy' was not operationally defined for respondents, nor were behavioural examples provided. Responses therefore reflect owners' subjective assessments of their cat's happiness and adjustment, at the time of survey completion, rather than standardised behavioural criteria. Further, questions should be designed to avoid assumptions about baselines that may affect interpretation of results, or include explicit measures for baselines to avoid misinterpretation of data. For instance, some homes may have already been well set up for indoor housing prior to transition, reducing the need for environmental modifications. However, current wording would place these participants in the same category as participants without suitable housing who also did not made environmental modifications, limiting the ability to validly interpret results. Environmental enrichment is known to be critical for animal welfare, especially in controlled environments such as indoors (Lima et al., 2026). The relationship between environmental modifications and cat welfare within indoor only environments is therefore likely to warrant further investigation. Future studies should include baseline measures for environmental conditions and investigate these relationships with larger sample sizes.

Participants, self-selected through CANZ networks to participate, may have an above-average interest in cat welfare, and may therefore not be representative of the general cat-owning population. A survivorship bias may also have existed, in that those with a successful transition experience may have been more likely to participate while unsuccessful people chose not to. Ten participants reported that their cat still had unsupervised outdoor access, suggesting that these cats were still transitioning to indoor-only living, that the transition had been unsuccessful or that the owners had chosen to reinstate outdoor access post-transition. While these participants were retained in descriptive and qualitative analysis due to the potential relevance of their experiences, their inclusion introduces variation that may have influenced results. For instance, any measures of stress, indoor resource use, activity levels, or behavioural changes for cats with continued outdoor access may not be comparable to those of cats kept exclusively indoors. Further, intermittent outdoor access may have reinforced certain behaviours (e.g., excessive vocalisation) and/or introduced an element of unpredictability that may have increased stress in these cats (Amat et al., 2016), potentially affecting the study’s findings.

Together, these factors may limit the homogeneity of the sample and the interpretability of findings. there are likely the challenges reported by owners likely differ from those whose cats were kept exclusively indoors. As a result, their inclusion may have introduced additional variability into the dataset, potentially diluting or obscuring effects attributable specifically to indoor-only living. Future studies that employ larger sample sizes, control for cat background data and collect prospective and objective data on cat transitions indoors are needed.

5. Conclusion

The owner experiences of transitioning cats indoors reported within this study suggest that, for most owners and cats, a transition to indoor cat management is manageable and worthwhile. Cat safety was the most common motivation given for transitioning cats indoors, as well as the most commonly cited benefit, suggesting that safety-focused messaging may be the most effective approach for increasing uptake of indoor cat husbandry. Challenges reported by owners included practical challenges, such as doorway management, litter maintenance, and providing adequate enrichment, as well as emotional challenges such as feelings of guilt and concern for their cat’s welfare. These challenges represent valuable targets for improving owner education and support. Younger cat age at time of transition was associated with a faster adjustment period, suggesting that earlier intervention, where possible, may have higher chances of success. While veterinary bills were reported to reduce following transition, an overall increase in financial burden was reported, highlighting a need to consider socioeconomic factors in any future cat management interventions or policies. That many transitions were prompted by unexpected circumstances (e.g., cat health, safety or owner housing changes) underscores the importance of accessible resources for owners who may have little time to prepare. This study further adds to the growing body of research indicating that cat management impacts the welfare and wellbeing of both cat and owner and that both need to be considered and supported for successful indoor management to occur.

CRediT authorship contribution statement

Julia S.L. Henning: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Nicola McDonald:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology,

Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Gosia Zobel:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Renee Railton:** Writing – review & editing, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Natalie Waran:** Writing – review & editing, Project administration, Investigation, Funding acquisition, Data curation, Conceptualization. **Susan J. Hazel:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

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Declaration of Generative AI and AI-assisted technologies in the writing process

No generative AI or AI-assisted technologies were used in the writing of this manuscript.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.applanim.2026.107120.

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