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FEATURE ARTICLE

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Executive functions and household chores: Does engagement in chores predict children's cognition?

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Abstract

Introduction: The benefits of completing household chores appear to transfer beyond managing day-to-day living. It is possible that chore engagement may improve executive functions, as engagement in chores require individuals to plan, self-regulate, switch between tasks, and remember instructions. To date, little research has been conducted on household chores and executive functions in children, for whom these skills are still developing.

Methods: Parents and guardians ($N = 207$) of children aged 5–13 years ($M = 9.38$, $SD = 2.15$) were asked to complete parent-report questionnaires on their child's engagement in household chores and their child's executive functioning.

Results: Results of the regression model indicated that engagement in self-care chores (e.g., making self a meal) and family-care chores (e.g., making someone else a meal) significantly predicted working memory and inhibition, after controlling for the influence of age, gender, and presence or absence of a disability. For families with a pet, there was no significant relationship between engagement in pet-care chores and executive function skills.

Conclusion: We strongly recommend that further research explore the relationship between chores and executive functions. It is possible that parents may be able to facilitate their child's executive function development through encouraging participation in chores, whereas chore-based interventions (e.g., cooking programmes) may also be used to target deficits in ability.

KEYWORDS

activities of daily living, child behaviour, child development, executive functions, pet–owner relationships

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1 | INTRODUCTION

Both adults and children engage in a wide variety of daily tasks related to household labour, including activities such as food preparation and cleaning. Such tasks, commonly referred to as 'chores', allow individuals to meet basic dietary and hygiene needs (Klein et al., 2009). It also appears that completing household chores has benefits beyond managing simple day-to-day living. In children, studies have found that engaging in age-appropriate chores can increase feelings of autonomy (Weisner, 2001) and is associated with improved prosocial behaviours and greater life satisfaction (White et al., 2019). Of emerging interest is the purported relationship between engagement in household chores and child cognitive development (Rende, 2021), particularly executive functioning. While there is some evidence to suggest that engagement in household chores is associated with the retainment of executive functions in older adults (Lee, 2018; Treiber et al., 2011; Wang et al., 2011), few studies have explored this relationship in children, for whom these skills are still developing.

'Executive functions' is an umbrella term for an array of cognitive processes associated with self-regulation and goal-directed behaviour (Diamond, 2012). Executive functions are commonly defined as (a) working memory (WM), the ability to monitor and manipulate temporary information; (b) inhibition, the ability to inhibit automatic responses or suppress irrelevant information to focus on a task; and (c) shifting, referring to the ability to move focus between tasks (Diamond, 2006; Miyake et al., 2000). Typically, these skills begin to develop in early childhood and continue to develop into late adolescence and early adulthood (Diamond, 2012), with some variance associated with upbringing and cultural background (Schirmbeck et al., 2020). Some children may experience delays in the development of these skills, with these delays commonly associated with neurodevelopmental conditions such as autism spectrum disorder and attention-deficit/hyperactivity disorder (Hill, 2004).

Impairments or delays in executive functioning can lead to difficulties in the ability to self-regulate, plan, and problem solve (Moffitt et al., 2011). Such difficulties have broader implications, as the successful attainment of these skills in early childhood is associated with later reading performance and mathematical ability (McKinnon & Blair, 2019) and is a predictor of overall academic achievement in later childhood (Willoughby et al., 2011, 2019). Additionally, studies have found a relationship between early executive functioning ability and engagement in tertiary education (Ahmed et al., 2021), and research has suggested that poor self-control in early childhood is associated with poorer physical health (Moffitt et al., 2011; cf. Ahmed et al., 2021) and poorer financial status in adulthood (Moffitt et al., 2011).

Key points for occupational therapy

1. Self-care chores (e.g., making self a meal) and family-care (e.g., making someone else a meal) significantly predicted working memory and inhibition.
2. It is possible that interventions that incorporate household chore-like activities (e.g., cooking or gardening) may be used to improve executive functions.
3. Parents may be able to use age- and ability-appropriate chores to facilitate the development of executive functions.

Fortunately, research indicates it is possible to improve executive functions (Diamond & Lee, 2011). From an occupation-centred perspective, executive functions may be improved by developing individualised learning activities and routines, which directly target deficits in planning, turn-taking, and monitoring skills (Frolek Clark et al., 2021; Frolek Clark & Schlabach, 2013; Maeir et al., 2014). Additionally, occupational therapists can support the role that parents play in the development of their child's cognitive abilities (Frolek Clark et al., 2021). Outside of a therapeutic context, as suggested by Júlio et al. (2019), household chores require individuals to exercise executive function skills by planning, self-regulating, remembering instructions, and switching between tasks. As chores require the use of executive functions, it is therefore possible that greater engagement in household chores may predict or even improve executive functioning ability in children. To date, little research has explored this relationship. When conducting research on chores, it is important to recognise that parents have different expectations for their children's engagement in chores, often dependent upon the child's gender and level of functioning (Blakemore & Hill, 2008; Crouter et al., 2001). Cultural background may also influence child participation in chores (Coppens & Rogoff, in press); however, it does appear that daughters are more likely to engage in household chores than sons, regardless of background (Coppens et al., 2016; Sani, 2016). Research also indicates that younger children are better at completing chores related to self-care (e.g., making one's own bed) compared with family care tasks (e.g., helping wash the dishes), whereas older children are capable of, and expected to complete,

both types of tasks (Bowes et al., 2001; Dunn, 2004; Dunn et al., 2014; Goodnow et al., 1991).

While previous studies have explored the differences in self-care and family-care chores (Bowes et al., 2001; Dunn, 2004; Dunn et al., 2014), one additional area that has yet to be examined is the benefits of children engaging in pet-care related chores. Estimates have suggested that pet ownership is rising globally, due to increasing urbanisation, access to disposable income, changes to family size, and an increase in solo living (Alexander et al., 2020; Growth From Knowledge, 2016). As most children display a natural affinity towards animals (LoBue et al., 2013), and parents have reported that they are comfortable with children taking responsibility for some pet-care related tasks, such as providing food, water, and exercise and toileting opportunities (Muldoon et al., 2015), this chore type should be explored further.

The primary aim of the present study was to explore whether engagement in age-appropriate household chores could predict executive functioning, for children aged between 5 and 13 years. Executive functions were measured using a parent-report measure, as is standard in the literature, to provide an ecologically valid insight into everyday child behaviour (Shimoni et al., 2012; Wallisch et al., 2018). It was hypothesised that children who took on more household responsibilities would have greater executive function ability than children who did not complete household chores. Self-care, family-care, and pet-care related chores were explored separately, to determine which, if any, type of chore best predicted executive function ability.

2 | METHOD

2.1 | Participants

Individuals who were at least 18 years of age, fluent in English, and who were the parent or legal guardian of a child aged between 5 and 13 years of age were invited to participate. Data were collected between 5 July 2020 and 31 August 2020, using the Qualtrics web-based survey platform (www.qualtrics.com; Provo, UT, USA). Participants were recruited via social media, online parenting forums, and through the professional contacts of the research team. Participants were also encouraged to share the survey link with other parents. In August 2020, the study was advertised on a regional Australian television network channel and published within a local newspaper.

A total 281 individuals participated in the online survey. Respondents were excluded from analysis if they did not complete the executive function measure. The final sample size was 207. Participants were aged between 20 and 58 years ($M = 38.70$, $SD = 6.60$), and most participants were female ($n = 190$; 91.8%). The survey respondents represented 15 different countries across Europe, North America, Asia, and Oceania, with most of the participants living in Australia ($n = 150$; 73.9%), the United Kingdom/Northern Ireland ($n = 14$; 6.9%), the United States of America ($n = 12$; 5.9%), New Zealand ($n = 7$; 3.4%), and Germany ($n = 6$; 3.0%). The majority of participants identified as Caucasian ($n = 161$; 77.8%) or Asian ($n = 22$; 10.6%).

Most participants were employed part-time (≤39 hours per week; $n = 59$; 28.5%) or full-time ($n = 38$; 28.5%). Other participants reported they were students ($n = 24$; 11.6%), self-employed ($n = 21$; 10.1%), homemakers ($n = 17$; 8.2), or were looking for work ($n = 6$; 2.9%). Data were collected during the COVID-19 pandemic, and as such, some participants reported changes in employment, including working from home ($n = 25$; 12.1%) or losing employment due to the pandemic ($n = 7$; 3.4%).

2.2 | Materials

2.2.1 | Demographics

The participants were asked to provide demographic data for both themselves and for their child. This included the age, gender, and socio-economic status of the participant, as well as the age and gender of their child, and if their child had any disabilities. Additional questions were provided to pet owners, such as pet species, pet age, and years of ownership.

To account for any impact of COVID-19 on behaviour, participants were asked if their child has engaged in a different level of chore completion since the beginning of the pandemic (1 = *fewer chores than usual*, 2 = *the same amount of chores as usual*, to 3 = *more chores than usual*). An additional open-ended question was provided to participants, 'Is there anything more you would like to say about COVID-19, and the responsibilities of your child?'

2.2.2 | Childhood executive functioning inventory (CHEXI; Thorell & Nyberg, 2008; https://chexi.se/)

The CHEXI is a 24-item questionnaire that measures children's executive function abilities using parent- or teacher-reports. The CHEXI has been developed for

children aged 4 to 12 years and is appropriate for use across all abilities. Each item is measured using a 5-point scale, with a higher score indicating larger executive function deficits. The CHEXI has four subscales, exploring WM, planning, regulation, and inhibition. The CHEXI is scored by summing the WM and planning subscales into a total 'Working Memory' scale ($\alpha > 0.85$) and by summing regulation and inhibition into a total 'Inhibition' score ($\alpha > 0.85$). The CHEXI has demonstrated moderate test–retest reliability ($r = 0.74$) and low-moderate criterion validity with laboratory measures of executive function ($r = 0.19$–0.39) and the Attention Deficit/Hyperactivity Disorder Rating Scale IV ($r = 0.27$–0.36).

2.2.3 | Children helping out: Responsibilities, expectations, and supports (CHORES; Dunn, 2004)

The CHORES is a 34-item questionnaire that collects parent-report data on children's engagement in household chores. The CHORES is an occupation-centred measure that was developed to address how child age and cultural background may influence chore engagement and to examine the level of parental assistance required to complete a task (Dunn, 2004; Dunn et al., 2014). It was developed for children and adolescents aged 6–14 years and is appropriate for children of all abilities. The CHORES has two subscales, measuring Self-Care ($\alpha = 0.96$) and Family Care ($\alpha = 0.98$) tasks, referring to tasks that solely affect the child or involve other members of the family, respectively. The CHORES has demonstrated strong test–retest stability (intraclass correlation coefficient [ICC] $= 0.94$) and internal consistency ($r = 0.93$), with the Self-Care ($\alpha = 0.96$) and Family Care ($\alpha = 0.98$) subscales also showing strong internal consistency.

The CHORES contains one item on pet care, asking if the child feeds the pet. To expand upon the pet care-related chores a child may engage in, nine additional questions were developed by the research team. These questions were based on research by Muldoon et al. (2015), who stated that children can be responsible for providing food, water, and exercise, as well as grooming and toileting a pet. An example item is '[My child] brushes or grooms pet'.

2.2.4 | Cat/Dog–Owner Relationship Scale (C/DORS; Howell et al., 2017)

Pet owners were asked to complete the C/DORS on behalf of their child. This encompasses items from the Monash Dog–Owner Relationship Scale (MDORS; Dwyer et al., 2006) and the Cat Owner Relationship Scale (CORS; Howell et al., 2017). The full C/DORS is a 33-item self-report questionnaire (Howell et al., 2017), which has previously been used to explore overall pet ownership (Bowen et al., 2020, 2021). This questionnaire explores how individuals view their own relationship with their pet, so it was slightly modified for the current study to ask parents to reflect on their child's relationship with the family pet. Individuals with more than one pet were asked to report on the pet that their child interacts with the most.

The questionnaire has three subscales measuring Perceived Emotional Closeness, Perceived Costs, and Pet–Owner Interaction. The reliability of the combined C/DORS is yet to be established, but the MDORS has demonstrated strong internal consistency for the Perceived Emotional Closeness ($\alpha = 0.84$) and Perceived Costs ($\alpha = 0.80$) subscale and moderate internal consistency for the Pet-Owner Interaction ($\alpha = 0.67$) subscale (Dwyer et al., 2006). For the CORS, all subscales have demonstrated strong internal consistency ($\alpha > 0.70$). For the purposes of this study, only the 11 items in the Pet–Owner Interaction subscale were included, and the stem for each question was modified to refer to a child. Each question was measured on a 6-point scale. As some questions may not be relevant to certain pet species, a 'not applicable' option was provided.

2.3 | Procedure

This project was approved by the La Trobe University Human Research Ethics Committee (Approval Number: HEC20247). The CHEXI and CHORES scales were presented to all participants. If the participants answered 'yes' to owning a pet in the demographic section, additional questions were provided, and the participants were also presented the pet-related CHORES questions and the C/DORS subscale. All parents were asked if their child's engagement in chores had changed since COVID-19.

2.4 | Data analysis

Data were imported from Qualtrics to the Statistical Package for the Social Sciences (SPSS; version 23.0) program for analysis. Preliminary data were screened for errors as per Pallant (Pallant, 2013, pp. 44–86). Two outliers were identified in the total self-care chores score and the total family care score, respectively. As the mean and 5% trimmed mean were similar across variables, outliers were retained (Pallant, 2013). One of these outliers

reflected a child with a traumatic brain injury. Kolmogorov–Smirnov tests indicated that WM ($P = 0.027$) and inhibition ($P = 0.025$) violated assumptions of normality, but as per Pallant (Pallant, 2013, p. 66) and Field (Field, 2013, pp. 184–185), this violation of normality is common in larger sample sizes, and as such, the data were not transformed.

Data were analysed from 207 parents and/or legal guardians. Descriptive analyses were conducted on the demographic information provided on the children of the participants. Frequency analyses were conducted on the individual CHORES items, using the binary performance data (0 = *does do*, 1 = *does not do*). These data were further analysed using a series of Chi-square tests for independence, to determine the association between engagement in chores and gender, using Yates' Correction for Continuity (Pallant, 2013). Effect sizes were calculated using phi (φ), with 0.1 = a small effect, 0.3 = a medium effect, and 0.5 = a large effect (Cohen, 1988). The association between engagement in chores and age was also explored, with age collapsed into three categories (5–7, 8–10, and 11–13 years). Associations between age and chore engagement were analysed using a series of Chi-square tests for independence, using the Pearson Chi-square value. Effect sizes were calculated using Cramér's V (φ_c), with 0.1 = a small effect size, 0.3 = a medium effect, and 0.5 = a large effect (Cramér, 1946; Pallant, 2013). A second frequency analysis was conducted on the COVID-19 chores engagement question, to explore whether the pandemic had impacted on chore engagement behaviour. For the CHEXI, as normality was violated, a series of Mann–Whitney *U* tests were conducted to explore WM and inhibition scales across gender. Kruskal–Wallis tests were run to determine the association between the three age categories and WM and inhibition. Effect sizes, where applicable, were calculated using Pearson *r* correlation coefficients (0.1 = small, 0.3 = medium, 0.5 = large; Cohen, 1988).

For the main analyses, the data were then analysed using a series of hierarchical regression tests, using WM and inhibition as the dependent variables. To control for the effect of demographics, the child age, gender, and presence/absence of disability were entered at Step 1. The chore types were analysed in individual hierarchical regression tests, with self-care chores, family care chores, and pet-care chores entered at Step 2.

3 | RESULTS

The children were aged between 5 and 13 years ($M = 9.38$, $SD = 2.15$), with a relatively even gender distribution (male children $n = 108$; 52.2%). One parent did not disclose their child's gender, and four parents did not report their child's age. The parents reported that 23 (11.1%) of the children had a disability, with autism spectrum disorder, attention-deficit/hyperactivity disorder, and dyslexia being the most common diagnoses. A majority of parents reported owning a pet ($n = 149$; 72.0%). Of these, 55 participants (37.9%) owned a single pet, 31 participants (21.4%) owned two pets, and 59 participants (40.7%) owned three or more. Four participants who reported owning a pet did not disclose the number they owned. For species type, dogs were the most commonly owned ($n = 72$; 34.8%), followed by cats ($n = 48$; 23.2), fish ($n = 5$; 2.4%), and birds, rabbits, and rodents ($n = 2$ each; 1.0%).

Half of the parents reported that, since the beginning of the pandemic, their child was completing the same amount of chores ($n = 103$; 50.5%). This was followed by parents reporting their child doing more chores than usual ($n = 77$; 37.7%). Only 24 (11.8%) participants reported that their child was doing fewer chores than usual. Data were missing for three participants. As shown in Table 1, results of the Chi-square tests for independence indicated significant associations between gender and chore engagement across five tasks, with small effect sizes. All but one effect size were negative, indicating that the female children engaged in more tasks than the male children. For age and chore engagement, a statistically significant, positive association was found across 28 variables, indicating that older children typically engaged in more chores than younger children. Of these significant variables, six had a medium effect size.

A Mann–Whitney *U* test revealed no significant difference in the WM of males ($Md = 30.50$, $n = 108$) and females ($Md = 30.00$, $n = 98$), $U = 4963$, $z = -0.77$, $P = 0.44$, $r = 0.05$, and no significant difference in the inhibition of males ($Md = 32.00$, $n = 108$) and females ($Md = 30.50$, $n = 98$), $U = 4773$, $z = -1.22$, $P = 0.22$, $r = 0.08$. For age, the younger age group (5–7 years) recorded a higher mean rank across the CHEXI, but the Kruskal–Wallis tests revealed no significant difference in WM χ^2 $(2, n = 203) = 0.98$, $P = 0.61$, or inhibition χ^2 $(2, n = 203) = 2.02$, $P = 0.36$.

For the main analyses, a series of hierarchical regression tests were performed on the total WM and inhibition scores, using the assistance scores for self-care chores, family care chores, and pet-care chores, as shown in Table 2.

Table 2 presents the results of the hierarchical regressions for WM. When introducing self-care-related chores as Step 2, the total variance explained by the model was 19.2%, F $(4, 196) = 11.65$, $P < 0.001$. Self-care-related chores explained an additional 4.8% of the variance in WM, R squared change = 0.05, F change $(1, 196) = 11.63$,

TABLE 1 Frequency analysis on CHORES items for the total sample size ($N = 207$) and as reported for the male ($n = 108$) and female ($n = 98$) participants and broken down by age

Child *does* the household chore	Total *n* (%)	Male *n* (%)	Female *n* (%)	φ	5–7 years *n* (%)	8–10 years *n* (%)	11–13 years *n* (%)	φ_c
Self-care subscale								
Puts own laundry in hamper	179 (86.5)	91 (84.3)	87 (88.8)	−0.07	38 (76.0)	76 (92.7)	61 (85.9)	0.19*
Makes self a snack	177 (85.5)	89 (82.4)	88 (89.9)	−0.11	37 (74.0)	71 (86.6)	65 (91.5)	0.19*
Cleans up after own play	173 (86.1)	94 (88.7)	78 (83.0)	0.08	38 (80.9)	69 (85.2)	63 (91.3)	0.12
Organises own belongings for school	162 (78.3)	87 (80.6)	75 (76.5)	0.05	29 (58.0)	68 (82.9)	63 (88.7)	0.30***
Organises own belongings for after-school events	162 (78.3)	64 (59.3)	61 (62.2)	−0.03	15 (30.0)	54 (65.9)	54 (76.1)	0.37***
Picks up own bedroom	156 (76.5)	82 (76.6)	73 (76.0)	0.01	30 (61.2)	70 (85.4)	53 (76.8)	0.22**
Makes self a cold meal	143 (69.1)	69 (63.9)	74 (75.5)	−0.13	21 (42.0)	56 (68.3)	64 (90.1)	0.40***
Puts away own clothes	141 (68.4)	66 (61.7)	74 (75.5)	−0.15*	24 (49.0)	60 (73.2)	54 (76.1)	0.24**
Makes own bed	121 (59.0)	53 (49.5)	68 (70.1)	−0.21**	18 (36.0)	57 (70.4)	44 (62.9)	0.28***
Sweeps or vacuums own room	98 (47.3)	47 (43.5)	50 (51.0)	−0.08	16 (32.0)	40 (48.8)	41 (57.7)	0.20*
Makes self a hot meal	73 (53.3)	35 (32.4)	38 (38.8)	−0.07	4 (8.0)	25 (30.5)	42 (59.2)	0.42***
Dusts own room	53 (26.1)	33 (33.0)	20 (20.8)	0.14	12 (26.7)	19 (23.8)	22 (31.9)	0.08
Family care subscale								
Sets or clears the tables	166 (80.2)	87 (80.6)	78 (79.6)	0.01	34 (68.0)	68 (82.9)	61 (85.9)	0.18*
Brings in or puts away groceries	141 (68.4)	79 (73.8)	62 (63.3)	0.11	27 (54.0)	55 (67.9)	56 (78.9)	0.20*
Picks up area shared by others	140 (67.8)	73 (67.6)	67 (69.1)	−0.02	34 (69.4)	57 (69.5)	46 (64.8)	0.05
Gets the mail or newspaper	127 (61.4)	64 (59.3)	63 (64.3)	−0.05	27 (54.0)	54 (65.9)	44 (62.0)	0.10
Dries dishes (unloads dishwasher)	117 (56.5)	58 (53.7)	59 (60.2)	−0.07	19 (38.0)	50 (61.0)	47 (66.2)	0.23**
Washes dishes (loads dishwasher)	115 (55.8)	54 (50.0)	60 (61.9)	−0.12	17 (34.7)	51 (62.2)	46 (64.8)	0.25**
Takes out the garbage/ recycling	114 (55.3)	71 (65.7)	42 (43.3)	0.23**	19 (38.0)	48 (59.3)	46 (64.8)	0.21**
	103 (49.8)	51 (47.2)	52 (53.1)	−0.06	20 (40.0)	40 (48.8)	41 (57.7)	0.14

(Continues)

TABLE 1 (Continued)

Child *does* the household chore	Total *n* (%)	Male *n* (%)	Female *n* (%)	φ	5–7 years *n* (%)	8–10 years *n* (%)	11–13 years *n* (%)	φ_c
Prepares part of a cold meal for family								
Sweeps or vacuums home	95 (47.4)	45 (43.3)	49 (51.6)	−0.08	16 (32.7)	39 (49.4)	39 (57.4)	0.19*
Prepares part of a hot meal for family	94 (45.6)	44 (41.1)	50 (51.0)	−0.10	14 (28.6)	37 (45.1)	41 (57.7)	0.22**
Takes a phone message	80 (38.6)	36 (33.3)	44 (44.9)	−0.12	5 (10.0)	32 (39.0)	40 (56.3)	0.36***
Cares for younger siblings	79 (38.3)	40 (37.4)	38 (38.80	−0.01	15 (30.0)	36 (43.9)	27 (38.6)	0.11
Cares for plants	64 (31.1)	30 (28.0)	34 (34.7)	−0.07	15 (30.0)	29 (35.4)	18 (25.7)	0.09
Cares for other family members	63 (30.6)	30 (27.8)	32 (33.0)	−0.06	10 (20.0)	29 (35.4)	21 (30.0)	0.13
Runs errand	63 (30.4)	36 (33.3)	27 (27.6)	0.06	8 (16.0)	20 (24.4)	33 (46.5)	0.27***
Cleans bathroom	58 (20.8)	29 (26.9)	29 (29.6)	−0.03	8 (16.0)	24 (29.3)	25 (35.2)	0.16
Sorts laundry for family	54 (26.2)	24 (22.4)	30 (30.6)	−0.09	6 (12.0)	27 (33.3)	20 (28.2)	0.19*
Dusts the house	54 (26.1)	27 (25.0)	27 (25.0)	−0.03	14 (28.0)	28 (34.1)	11 (15.5)	0.19*
Puts laundry away for family	51 (24.6)	26 (24.1)	25 (25.5)	−0.02	8 (16.0)	25 (30.9)	17 (23.9)	0.14
Runs washer/dryer	45 (21.7)	27 (25.0)	18 (18.4)	0.08	3 (6.0)	20 (24.4)	21 (29.6)	0.22**
Pet-care scale								
Entertains or plays with the pet	134 (89.9)	67 (85.9)	67 (95.7)	−0.17	26 (78.8)	53 (91.4)	52 (96.3)	0.23*
Provides food for pet	116 (77.9)	63 (80.8)	53 (75.7)	0.06	22 (66.7)	44 (75.9)	47 (87.0)	0.19
Provides water for pet	114 (77.0)	56 (72.7)	58 (82.9)	−0.12	21 (65.6)	45 (77.6)	45 (83.3)	0.16
Makes sure the pet is safe when visitors are in the house	107 (71.8)	53 (67.9)	54 (77.1)	−0.10	16 (48.5)	41 (70.7)	47 (87.0)	0.32***
Helps with training the pet	77 (51.7)	36 (46.2)	41 (58.6)	−0.12	12 (36.4)	27 (46.6)	35 (64.8)	0.23*
Takes pet outside for toilet breaks/cleans litter box or cage	76 (51.0)	38 (48.7)	38 (54.3)	−0.06	8 (24.2)	31 (53.4)	34 (63.0)	0.30**
Picks up after pet	69 (46.3)	32 (41.0)	37 (52.9)	−0.12	8 (24.2)	26 (44.8)	32 (59.3)	0.27**
Assists with putting the pet to bed for the night	64 (43.2)	27 (35.1)	37 (52.9)	−0.18*	10 (30.0)	24 (41.4)	27 (50.9)	0.16

(Continues)

TABLE 1 (Continued)

Child *does* the household chore	Total *n* (%)	Male *n* (%)	Female *n* (%)	φ	5–7 years *n* (%)	8–10 years *n* (%)	11–13 years *n* (%)	φ_c
Takes pet for a walk	61 (41.5)	26 (33.8)	34 (49.3)	−0.16	9 (27.3)	22 (38.6)	28 (52.8)	0.20
Brushes or grooms pet	60 (40.3)	23 (29.5)	37 (52.9)	−0.24**	10 (30.3)	18 (31.0)	30 (55.6)	0.25**

*$P < 0.05$. **$P < 0.01$. ***$P < 0.001$.

TABLE 2 Hierarchical regression analyses summaries for working memory, across self-care related chores, family-related chores, and pet-care related chores

Step and predictor variable	*B*	*SE B*	*β*	R^2	ΔR^2
Step 1				0.14***	
Child age	−0.21	0.31	−0.05		
Child gender	0.56	1.34	0.03		
Child disability	12.03	2.12	0.38		
Step 2				0.19***	0.05***
Self-care chores	−0.16	0.05	−0.26		
Step 1				0.14***	
Child age	−0.21	0.31	−0.05		
Child gender	0.56	1.34	0.03		
Child disability	12.03	2.12	0.38		
Step 2				0.19***	0.05***
Family-related chores	−0.16	0.05	−0.23		
Step 1				0.18***	
Child age	−0.12	0.38	−0.03		
Child gender	0.75	1.53	0.04		
Child disability	12.61	2.31	0.42		
Step 2				0.19	0.16
Pet-care-related chores	−0.05	0.04	−0.10		
Pet interaction	−0.04	0.06	−0.05		

***$P < 0.001$.

$P < 0.001$. In the final model, only child disability ($\beta = 0.36$, $P < 0.001$) and self-care chores ($\beta = -0.26$, $P < 0.001$) were significant.

In a separate analysis, when family-related chores were introduced at Step 2, the total variance explained by the model was 18.8%, F (4, 196) = 11.33, $P < 0.001$. Family-related chores explained an additional 4.4% of the variance in WM, after controlling for age, disability, and gender, R squared change = 0.04, F change (1, 196) = 10.54, $P < 0.001$. Only disability ($\beta = 0.34$, $P < 0.001$) and engagement in family-related chores ($\beta = -0.23$, $P < 0.001$) were statistically significant in the final model.

A third analysis was conducted on families ($n = 149$) who reported owning a pet. After the entry of pet-care related chores and the C/DORS scale were entered at Step 2, the total variance of the model was 18.9%, F (5, 137) = 6.39, $P < 0.001$. Pet-care chores and pet interaction contributed a low, non-significant additional variance, R squared change = 0.01, F change (2, 137) = 0.59, $p = .56$. Only disability ($\beta = 0.41$, $p < .001$) was statistically significant in the final model.

The results for inhibition are presented in Table 3.

As shown in Table 3,when entering self-care related chores in Step 2, the total variance of the model was 10.9%, F (4, 196) = 6.00, $P < .001$, with self-care chores explaining an additional 5.3% of the variance in inhibition, R squared change = 0.05, F change (1, 196) = 11.62, $P < 0.001$. In the final model, only disability ($\beta = 0.188$, P

TABLE 3 Hierarchical regression analyses summaries for inhibition, across self-care-related chores, family-related chores, and pet-care related chores

Step and predictor variable	*B*	*SE B*	*β*	R^2	ΔR^2
Step 1					
Child age	−0.39	0.26	−0.10	0.06**	
Child gender	0.90	1.13	0.05		
Child disability	5.30	1.78	0.21		
Step 2					
Self-care chores	−0.13	0.04	−0.27	0.11***	0.05***
Step 1					
Child age	−0.39	0.26	−0.10	0.06**	
Child gender	0.90	1.13	0.06		
Child disability	5.30	1.78	0.21		
Step 2					
Family-related chores	−0.17	0.04	−0.30	0.13***	0.07***
Step 1				0.08**	
Child age	−0.36	0.31	−0.09		
Child gender	1.40	1.26	0.09		
Child disability	5.89	1.91	0.25		
Step 2				0.10	0.07
Pet-care-related chores	−0.06	0.04	−0.18		
Pet interaction	−0.01	0.05	−0.02		

**$P < 0.01$. ***$P < 0.001$.

< 0.05) and self-care chores ($\beta = -0.27$, $P < 0.001$) were statistically significant.

In a second analysis, when entering family-related chores in Step 2, the total variance of the model was 13.0%, F (4, 196) = 7.32, $P < 0.001$. Family-related chores explained an additional 7.4% of the variance in inhibition, R squared change = 0.07, F change (1, 196) = 16.62, $P < 0.001$. In the final model, only disability ($\beta = 0.16$, $P < 0.05$) and engagement in family-care chores ($\beta = -0.30$, $P < 0.001$) were statistically significant.

After the entry of pet-care related chores and pet interaction at Step 2, the total variance of the model was 10.3%, F (5, 137) = 3.16, $P < 0.05$. Pet-care chores and pet interaction contributed a low, non-significant additional variance, R squared change = 0.07, F change (2, 137) = 1.85, $P = 0.16$. In the final model, only disability ($\beta =$ 0.24, $P < 0.05$) was statistically significant.

4 | DISCUSSION

The aim of the present study was to explore whether child engagement in household chores, including tasks related to self-care, family-care, and pet-care, could predict executive functioning. It was hypothesised that children who engaged in more household chores would have better inhibition and WM, as reported by their parents or guardians. We found evidence to partially support our hypothesis. The results of the regression models indicate that engagement in both self-care and family-care chores predict WM and inhibition, after controlling for the influence of age, gender, and presence or absence of disability. There was no evidence of a relationship between engagement in pet-care chores and executive functioning.

The relationship between self-care chores and family-care chores and executive functioning has significant implications, both in the occupational therapy field and for families. Our findings likely reflect that most chores require individuals to self-regulate, maintain attention, plan, and switch between tasks (Júlio et al., 2019), thereby supporting the development of executive functioning. We also posit that, as there is an association between fine and gross motor skills and executive functioning, the physicality of some chores may also contribute to this relationship (McClelland & Cameron, 2019). However, the cross-sectional design and use of regression analyses in this study mean the directionality of the relationship cannot be determined. It is possible that engagement in household chores can improve executive

functioning, but it is also possible that children who display stronger executive function skills are more willing to engage in chores or are expected by their family to do more.

The possibility that engaging in chores can improve executive functioning warrants further research, particularly as few studies exist. Of the available literature, one study found that participation in a computer-simulated cooking intervention improved executive functioning in older adults (Wang et al., 2011). While the complexity of digital cooking tasks differs from real-life cooking, this study nonetheless provides preliminary evidence that participating in daily household chores may improve executive functioning (Wang et al., 2011). No comparable research has been conducted for children, but child-focused cooking and gardening programmes have found improvements in children's self-confidence, self-efficacy, and team building skills (Davis & Brann, 2017; Utter et al., 2017), suggesting such programmes have transferrable benefits that may expand to executive functioning. Such programmes may be incorporated into wider educational environments; while not all schools will have the resources to do so, in countries such as Australia and England, the school curriculum includes mandatory food and wellbeing education (Australian Curriculum, n.d.; Department for Education, 2015), with spaces often dedicated to teaching food preparation (Ronto et al., 2016).

School-based programmes, such as cooking, may be more accessible to families who cannot participate in other, established executive function interventions, which often have cost- or accessibility-associated barriers (Diamond & Lee, 2011). Additionally, the use of occupation-centred executive function interventions is still developing, and to date, the efficacy of such programmes is still uncertain (Josman & Meyer, 2019). The family-centred Cognitive Functional intervention, which teaches goal setting through the incorporation of games, has been limited by small sample sizes (Hahn-Markowitz et al., 2011; Maeir et al., 2014) and a decline in improvement at follow-up (Hahn-Markowitz et al., 2011). This highlights the need for further research exploring the use of executive functioning interventions, including the long-term outcomes and overall generalisability, as well as highlighting the scarcity of interventions available to occupational therapists.

As parents play a significant role in developing their child's general work ethic, the household is a key place where chore-related behaviour can be developed (ter Bogt et al., 2005). While some children may struggle to engage in chores independently (Spaulding et al., 2021), overall, encouraging children to participate in age- or ability-appropriate chores is likely implementable in most households. Indeed, research suggests that young children often willing engage in altruistic helping behaviours (e.g., put clothes in the laundry; throw away rubbish; Hammond et al., 2017), with a review suggesting that such chore engagement increases throughout childhood (dEntremont et al., 2017). This home environment is also suitable for occupation-based interventions, with occupational therapists able to work directly with the child (Laverdure et al., 2021). In this same context, therapists may provide parental coaching for families that require support in developing their child's chore engagement (Laverdure et al., 2021).

There was no relationship between executive functioning and pet-care chores, which was unexpected because interaction with animals may improve executive functioning (Diamond & Ling, 2016). This theory is based on research suggesting that animals act as a social support and can improve mood, which is associated with optimal cognitive functioning (Diamond, 2012; Diamond & Ling, 2016). In the present study, most families reported that their child played with the pet and provided food and water. As such, the non-significant results probably do not reflect a low level of engagement. It is, however, possible that tasks such as pouring kibble or water into a bowl are not complex or challenging enough to aid in the development of executive functioning, compared with chores like cooking which require multiple steps (Diamond & Lee, 2011).

This study had several limitations, which are mainly attributable to the measures used. For example, the CHEXI scale (Thorell & Nyberg, 2008) has demonstrated low criterion validity when compared with performance-based measures of executive functioning. However, this is not unexpected, as past studies have found low correlations between performance-based and report measures of executive functioning, with these measures appearing to test different underlying executive functioning constructs (Toplak et al., 2013). For the CHORES scale (Dunn, 2004), a significant limitation is that this questionnaire does not report on the frequency of behaviour but only the level of assistance required. As such, while most families reported that their child engages in chores such as putting their own laundry in the hamper, it is unknown whether this is a regular occurrence. This lack of frequency data has implications is particularly relevant for the tasks related to pets, as research has indicated that parents often prevent children from taking an active role in pet-care (Muldoon et al., 2015).

While age, gender, and the presence or absence of a disability were controlled for in our study, future research should control for additional socio-demographic confounders. This includes the exploration of child ethnicity, the overall family structure (such as birth order or number of children in the family), socio-economic status,

employment history, and educational background (Yu et al., 2020). These factors are related to both executive functioning and parental expectations surrounding chore engagement (Coppens et al., 2016; Sani, 2016; Thorell et al., 2013). In controlling for these variables, as well as exploring the frequency of chore-related behaviour, future research will be able to provide a more accurate understanding of children's engagement in chores and how this engagement relates to executive functioning.

This study was conducted during the COVID-19 pandemic. While some individuals have seen an increase in working hours, other individuals have had reduced hours, lost their employment, or transitioned to working from home (Bick et al., 2020; Chatterjee et al., 2020). Schools have also been impacted by COVID-19, with many jurisdictions moving to remote learning (Van Lancker & Parolin, 2020; Viner et al., 2020). As such, it was possible that children have been expected to engage in different levels of household chores since the beginning of the pandemic; individuals who were terminated from their employment may have taken on-board extra responsibility at home, thus reducing the number of chores they expected their child to complete. Alternatively, individuals with increased work hours, such as health-care workers, may have expected their child to complete more chores, particularly if their child was spending more time at home. Surprisingly, most families reported that their child completed the same amount of chores as usual. This may reflect that most participants resided in Australia, with most areas of the country reporting zero cases of community transmission during the data collection period (Attwell et al., 2021).

4.1 | Conclusion

Executive functions are cognitive processes critical to planning, multitasking, and initiating goal-directed behaviours (Diamond, 2012). This study found a relationship between children's engagement in self-care and family-care chores and their WM and inhibitory skills. This relationship may have significant implications, as it is possible that targeted interventions, such as cooking programmes, could be utilised to improve these skills. In the household, parents may also be able to facilitate their child's executive functioning development by encouraging engagement in chores. It is recommended that future research focuses on establishing the directionality of this relationship.

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CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

AUTHOR CONTRIBUTIONS

All authors certify that they provided a substantial contribution to the concept and design of the study. DT conducted the analyses and wrote the manuscript with support and revision from TH and PB. All authors read and approved the final manuscript.

DATA AVAILABILITY STATEMENT

Data are available on request due to privacy/ethical restrictions.

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